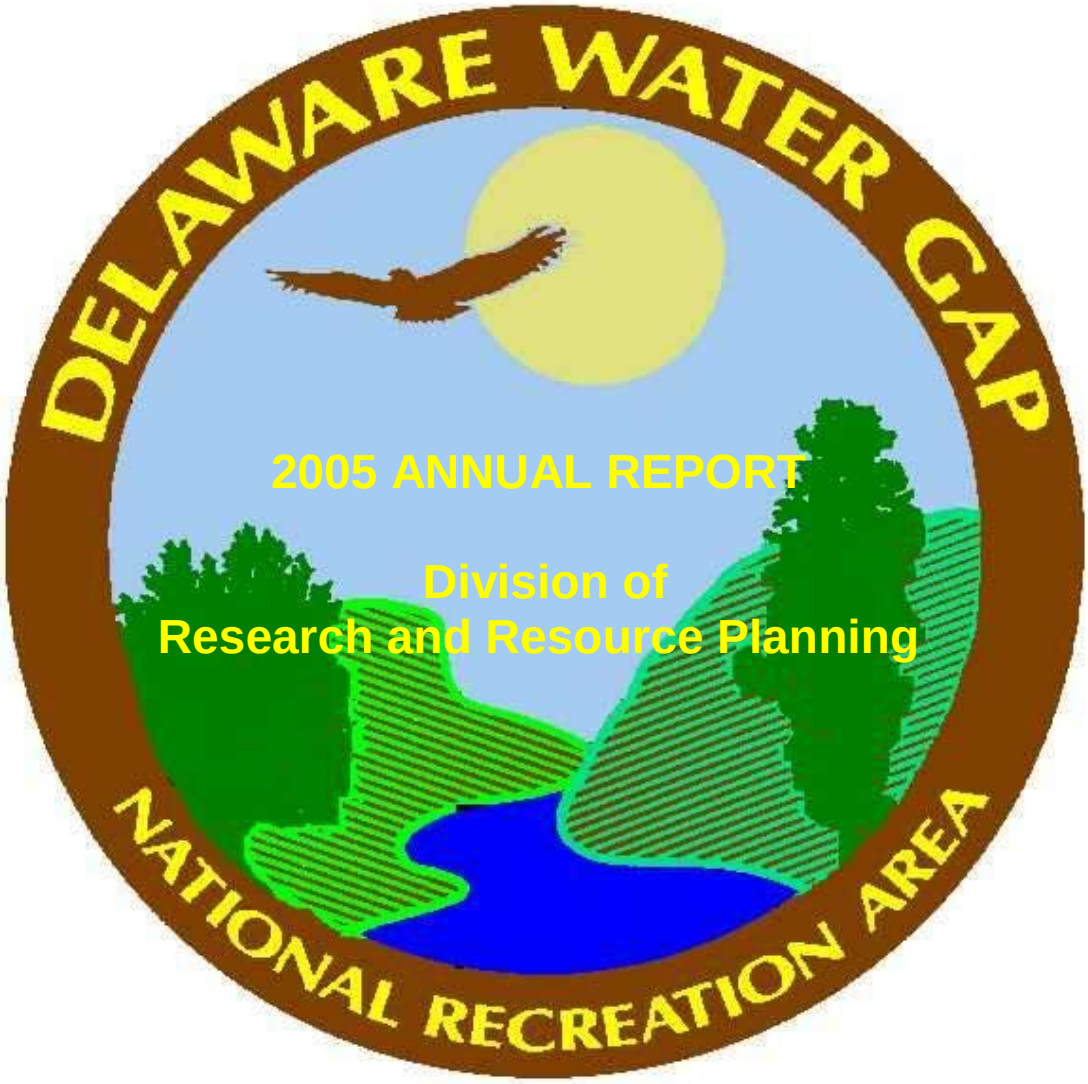
National Park Service
U.S. Department of the Interior



2005 ANNUAL REPORT

Division of
Research and Resource Planning

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March, 2006

Friends, Colleagues, Partners and General Readers:

Thank you for your interest in the Division of Research and Resource Planning at the Delaware Water Gap National Recreation Area. The reports that follow are from those program areas performed in 2005 that are the highest priority as identified in our divisional strategic plan.

Change was the primary constant both administratively and in the environment we worked in during 2005. Personnel wise, Leslie Morlock was hired to fill the GIS Specialist position and Patty Tipson was hired as a Biological Technician to monitor the resource impacts from the Columbia Gas Line replacement project. Additionally, our excellence in SCA staff was maintained by the hire of Matt Bennett and Allie Rath. The environmental climate was just as forthcoming this past year as was the new hires. The park experienced two significant, 100-year flood events within six months of each other. These storms rocked our world and slightly tilted some of our work priorities.

In spite of the flooding reactions we were able to move forward on most of our projects. In the science realm, we maintained over 50 research investigations while NEPA compliance work by many of the R&RP staff dominated most of our activities; the water quality study of park tributaries ended with the final report pending; the Columbia Gas pipeline replacement project was planned and started; hemlock forest research work advanced new ideas on managing this resource; exotic plant control advanced tremendously this past year through our regional exotic plant management team and through provisions in our agricultural leases; purple loosestrife control was increased via successful biological control efforts; inventory and monitoring of resources advanced as part of the Rivers and Mountains network; bald eagle nesting declined due at least in part to flood events; community planning efforts were expanded to include local watershed groups; and finally, in planning, our division drafted a new five-year strategic plan (under review).

The division also committed a large block of time to the George Wright Society Conference held in Philadelphia in March 2005. We moderated 2 sections, delivered 4 papers, posted 3 posters and entertained a field trip. Our park was well represented at this event!

Thank you for your support!

Patrick J. Lynch
Chief of Research and Resource Planning

THIS REPORT IS DEDICATED TO JOHN BEHLER (1943-2006)

We dedicate this year's report to John Behler - scientist, conservationist, dear friend. Most of us met John in 1999, shortly after he signed on to conduct field inventories of reptiles and amphibians in national parks throughout the northeast. His credentials were impressive – Curator of Herpetology at the Bronx Zoo, co-author of National Audubon Society's "Field Guide to Amphibians and Reptiles of North America," and chairman of the Word Conservation Union's tortoise and freshwater turtle group.

Working here at Delaware Water Gap was something of a homecoming for John. He was born in Allentown and earned his Master's degree at East Stroudsburg University. He knew and loved the park. During the three-year study, his field crew compiled an enormous dataset, documenting the occurrence and distribution of some of the park's least known animals, including timber rattlesnake, fence lizard, and bog turtle. When the need arose, he recruited Christina Castellano, doctoral student at Fordham University, to determine how best to protect the park's wood turtle population. The information obtained from these field inventories, accompanied by John's conservation recommendations, will help inform park management decisions for years to come.

By example, John showed us all what it takes to make a difference, to be a positive force for conservation. One day each week - and you could count on it - John made the long drive from home to be here, in the field, radio-tracking turtles. On those days, he did what he loved best, sharing his knowledge and skills with students and colleagues. His passion was contagious.

Many of us pictured John returning here in retirement, as a park volunteer scientist, continuing his life-long work. When his heart gave out on the last day of January, that all changed and the world lost a vital voice for conservation. We mourn his passing.

HEMLOCK ECOSYSTEMS and HEMLOCK WOOLLY ADELGID at DELAWARE WATER GAP NATIONAL RECREATION AREA

Prepared by

Richard A. Evans
Ecologist

Sampling hemlock tree upper crown branches at Childs Park, June 2005. (Photograph courtesy of Brad Onken, USDA Forest Service.)

ABSTRACT

Since 1993, the park has conducted a program to address the threats that hemlock woolly adelgid (HWA) and hemlock forest decline poses to valued park resources and visitor experiences. This program includes annual monitoring of HWA populations and hemlock tree health in permanent hemlock forest plots in the park, studies of ecosystems and biodiversity associated with hemlock dominated forests in the park, and efforts to manage HWA and maintain hemlock ecosystems and visitor use areas in the park, to the extent feasible. The efforts and support of many agencies and cooperators have contributed greatly to this HWA-Hemlock Program over the years. The support of the USDA Forest Service in particular, in the form of funding, labor, and technical assistance, has been critical to the success of this program.

HWA infestation levels during 2005 were low at Adams Creek and VanCampens, and moderate at Donkeys Corner and Mt. Minsi. New growth was abundant on hemlocks at all these sites. The flush of new growth produced in 2005 probably resulted from the very low HWA infestations at all these sites in 2004, and adequate soil moisture during the past two or three years. Eschtruth et al. (2006) estimated that, as of 2003, over 90% of hemlocks at Adams Creek, and about 70% of hemlocks at VanCampens Brook, had been infested with HWA.

A simple mathematical model was developed to describe the spread of HWA infestations throughout the park, and forecast hemlock decline in the future. The model indicates that within 10 to 20 years no healthy hemlocks will remain and 50% of hemlock will have died, and within 25 to 35 years, 90% of park hemlocks will have died. Although the accuracy of this model is uncertain, it provides a scientifically based forecast of what the future may bring, and may lead to improvements in measuring and modeling the dynamics of HWA infestations and hemlock tree health.

Preliminary results from the pilot HWA suppression project at Childs Park indicate that imidacloprid was successfully taken up by many of the trees receiving stem injections, and was present in upper crown branches as well as lower crown branches. However, imidacloprid was not taken up as readily as expected by trees receiving soil drench or soil injections.

Raymondskill Falls unfortunately needed to be closed from mid-July until early October, 2005, because of hazards from dead and dying trees. A total of 88 hazardous trees were cut down by a contractor; 72 of these (82%) were hemlock trees. Because of the steep, rugged terrain and limited access for heavy equipment, downed trees were left on site. A reforestation project is planned for this site with the goals of (1) preventing invasions of alien plants, (2) fostering regeneration of hemlocks and other desired tree species, (3) minimizing erosion, and (4) informing and educating the public.

INTRODUCTION

During the past 13 years the park has conducted a program to address the threats that HWA and hemlock forest decline poses to valued park resources and visitor experiences. The main goals of this program have been to:

1. Generate information about HWA and hemlock tree health in the park.
2. Identify and document the distinctive characteristics of park hemlock ecosystems.
3. Document the ecological effects of hemlock decline.
4. Manage HWA and maintain park hemlock ecosystems, to the extent possible.
5. Provide public information and technical assistance.

In earlier years of this program, efforts focused mainly on goals 1, 2, and 5. Goal 2 has been accomplished to a large degree, and the ability to address this goal further is now limited by the extent of hemlock decline that has occurred in the park. In recent years, efforts have shifted to focus more on goals 3 and 4.

Previous annual reports have provided thorough reviews of HWA and hemlock decline related issues in the park, and our research, monitoring, and management program to address those issues. Highlights of 2005 program activities and results are presented below.

HWA Infestations and Hemlock Health

HWA Populations and Hemlock Tree New Growth

In 2005, as in previous years, we collected data on HWA infestation levels and amount of new twig growth on hemlock trees associated with permanent plots in the park. Figure 1 shows average HWA infestation levels (percentage of twigs having HWA) and amount of new twig growth (percentage of twigs producing new growth) for each of the past 11 years at four sites. Looked at this way, HWA infestations during 2005 were low at Adams Creek and VanCampens, and moderate at Donkeys Corner and Mt. Minsi. Despite differences in HWA infestation levels, abundant new growth was produced at all these sites in 2005. This flush of new growth probably resulted from a combination of the very low HWA infestations at all these sites in 2004, and the abundance of soil moisture (little or no water stress on the trees) during the past two or three years.

Another way to look at the HWA infestation data is to track the percentage of hemlock trees in a stand that have been infested with HWA. Data summarized this way in Figure 2 (from Eschtruth et al. 2006) indicate that HWA has infested a significantly higher percentage of hemlock trees at Adams Creek than at VanCampens Brook. This may be one reason hemlock decline and understory vegetation changes have been more pronounced at Adams Creek than at VanCampens Brook (Eschtruth et al. 2006).

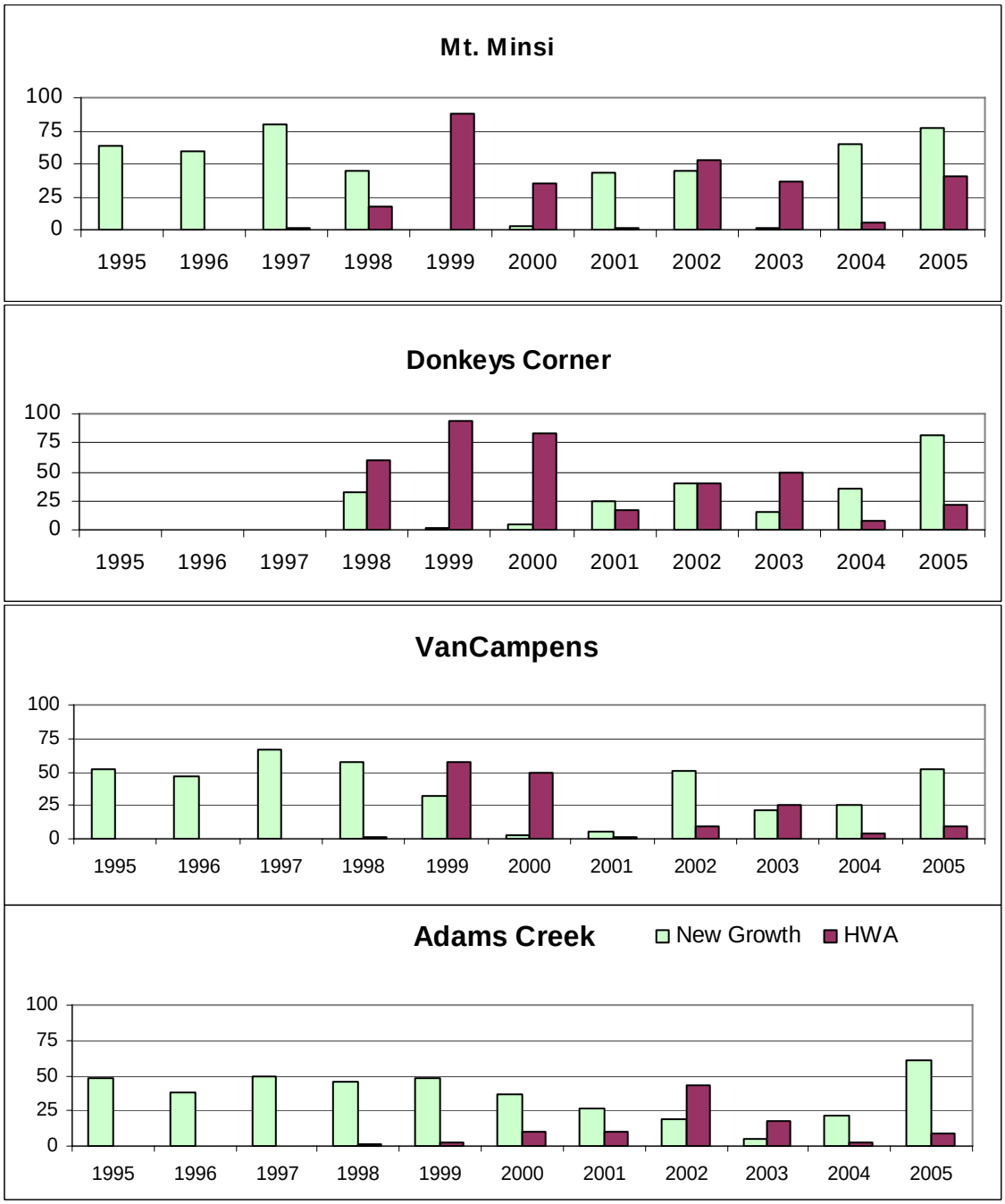

Figure 1. Average annual hemlock new growth (percent of twigs producing new growth; light green) and HWA infestation levels (percent of twigs infested with HWA; dark red) at each of four monitoring sites, from 1995 through 2005. Data were not collected at Donkeys Corner before 1998.

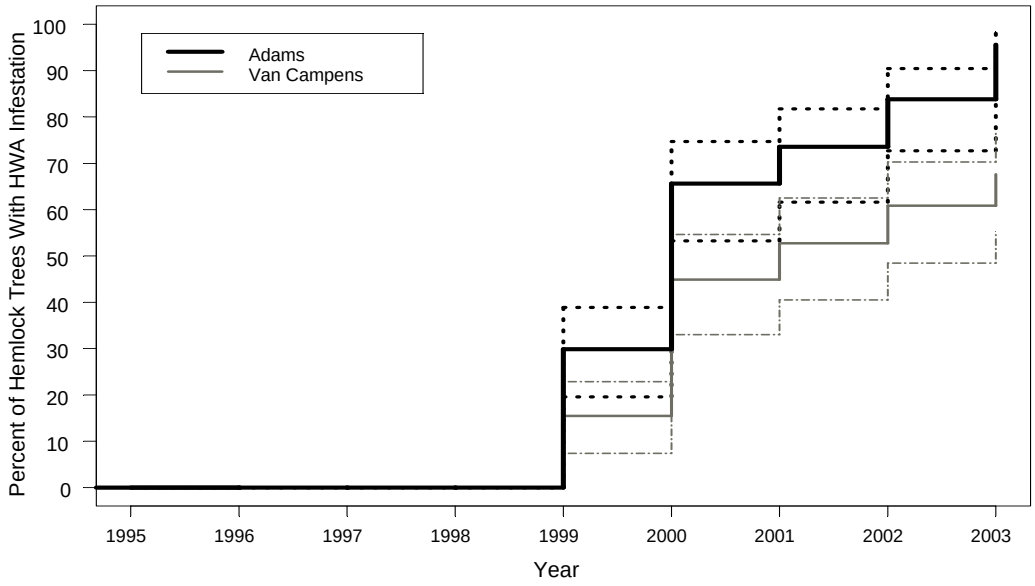

Figure 2 (from Eschtruth et al. 2006). Cumulative percent of hemlock trees infested with HWA at Adams Creek and VanCampens Brook ("Kaplan-Meier survival curves" of time until infestation), with 95% confidence intervals (dotted lines). As of 2003, over 90% of hemlock trees had been infested at Adams Creek, and about 70% of trees at VanCampens Brook. For this analysis, monitored hemlock trees were not categorized as infested until HWA was observed on >5% of branch terminals. Although HWA was present at both sites in 1995, no monitored hemlock trees met this criterion of infestation until 1999.

Forecasting Hemlock Decline

What might be the future of hemlock forests in the park? If HWA biocontrols or other HWA suppression methods are not very effective over large forested areas in the park, how likely is it that 50% or more of park hemlocks will die? How long might it be before 50%, or 90%, of park hemlocks die? Answers to questions like these would be useful for park planning and management. In addition, efforts to develop formal, scientifically based answers to these questions may lead to progress in scientific research, and more useful monitoring efforts.

As a first step to address these questions, a simple mathematical model with two parts was developed to (1) describe the spread of HWA infestations throughout the park, and (2) forecast the resulting hemlock decline. In the first part of the model, the "logistic" equation was adapted from its traditional use in population biology (Hutchinson 1978) for use to describe the cumulative percentage of hemlock trees in the park that become infested over time:

$$\text{Cumulative percent hemlocks infested up to the year "y"} = \frac{100}{1 + e^{-r\,y}}$$

where $e = 2.71828$ (the natural logarithm),
and $r =$ the maximum rate of spread of HWA (estimated from data, or assumed).

Because the estimate of "r" may not be accurate, two scenarios of HWA infestations spreading are presented here. The first scenario is based on an estimate (from park data) of

r = 0.2608 occurring in the year 2000

This scenario produces results quite consistent with data observed to date. The second scenario is based on

r = 0.20 set to occur in the year 2010.

The lower value of "r" assigned to a later date (2010) in this second scenario means that HWA infestations spread slower. Thus, the second scenario is more conservative or "optimistic" than the first scenario.

In the second part of the model, hemlock trees decline and die at assigned rates after having been infested. The model scenarios were set to fit the fact that, according to our permanent plot data, 93% of hemlocks were "healthy" in 1993 and 1994. In both model scenarios, hemlocks are removed from the "healthy" classification three years after HWA infestation. For hemlock mortality, both model scenarios assume that 20% of infested hemlocks die 5 years after initial HWA infestation, another 20% die after 10 years, another 20% die after 15 years, another 20% die after 20 years, 15% die after 25 years, and 5% survive indefinitely. The average of the various hemlock "dying times" after HWA infestation in this model is nearly 15 years. This mortality rate is much lower than early estimates that hemlocks die within five years of infestation (McClure 1991), but it may or may not be realistic.

The hemlock mortality rate is obviously critical to model predictions, and one of the important uses of our hemlock plot monitoring data is to provide estimates of the mean and variance of the hemlock decline and mortality rates. Now that we have more than 10 years of plot monitoring data, analysis has begun (but not completed) to estimate hemlock decline and mortality rates following HWA infestation.

The two scenarios of this model are shown in Figure 3. The first scenario (Fig. 3a) matches recent park data well: Something like 80% of hemlock trees have been infested with HWA, the annual hemlock mortality rate is about 2% (Eschtruth et al. 2006), about 20% of hemlock trees have died, and about 20% of hemlock trees remain healthy. Plot data do not indicate any healthy hemlocks remaining (see 2004 annual report), but that may be a result of small sample size (less than 2% of hemlock trees in the park are in plots) and sample bias (original plots were not randomly located throughout the park). In this scenario, by 2015 (within 10 years), no healthy hemlocks will remain, and 50% of all park hemlocks will have died. By 2030 (within 25 years), 90% of park hemlocks will have died.

The second scenario (Fig. 3b) is more optimistic than recent park data indicate. According to this scenario, approximately 70% of park hemlocks should still be healthy, and only about 5% should have died as of 2005. Yet, even in this scenario, by 2025 (within 20 years), no healthy hemlocks remain, and 50% will have died. By about 2040 (within 35 years) 90% of park hemlocks will have died.

In summary, these model scenarios indicate that within 10 to 20 years no healthy hemlocks will remain and 50% will have died, and within 25 to 35 years 90% of park hemlocks will have died. Although this model is very simple, it provides a scientifically based forecast of what the future may bring, and provides a basis for further improvements in measuring and modeling the dynamics of HWA infestations and hemlock tree health.

Management of HWA and Hemlock Stands

Chemical Suppression of HWA at Child's Park

A pilot project was initiated in 2004 with funding from the USDA Forest Service to evaluate the effectiveness of three different methods of applying imidacloprid to suppress HWA populations and maintain eastern hemlock tree health. Two methods of soil treatments (soil drench and soil injection) and one method of stem injection (Arborjet "Tree IV") are being tested at Child's Park. Imidacloprid was applied by all three methods on October 5, 2004.

The objectives of this project are to:

1. Determine concentrations of imidacloprid and its derivatives in lower and upper hemlock crown branches during June in two consecutive years following treatment in October.
2. Determine imidacloprid treatment effects on HWA populations of lower and upper crown branches during June in two consecutive years following treatment in autumn.
3. Determine imidacloprid treatment effects on new growth of lower and upper crown branches during June in two consecutive years following treatment in autumn.

Selection and pre-treatment assessment of the hemlock trees to be included in this project at Child's Park was conducted in June, 2004. A total of 48 hemlock trees were selected: 12 trees for each of the three treatment methods (a total of 36 trees received treatments), and 12 trees for controls.

Measurement of the diameter (at breast height) and height of each tree in the study were taken prior to treatment. Pre-treatment and post-treatment assessment of the 48 study trees includes the following:

1. Visual Crown Ratings.
2. HWA infestation level and new twig production on lower crown branches.
3. Elongate hemlock scale (EHS; *Fiorinia externa*) infestation level on lower crown branches.

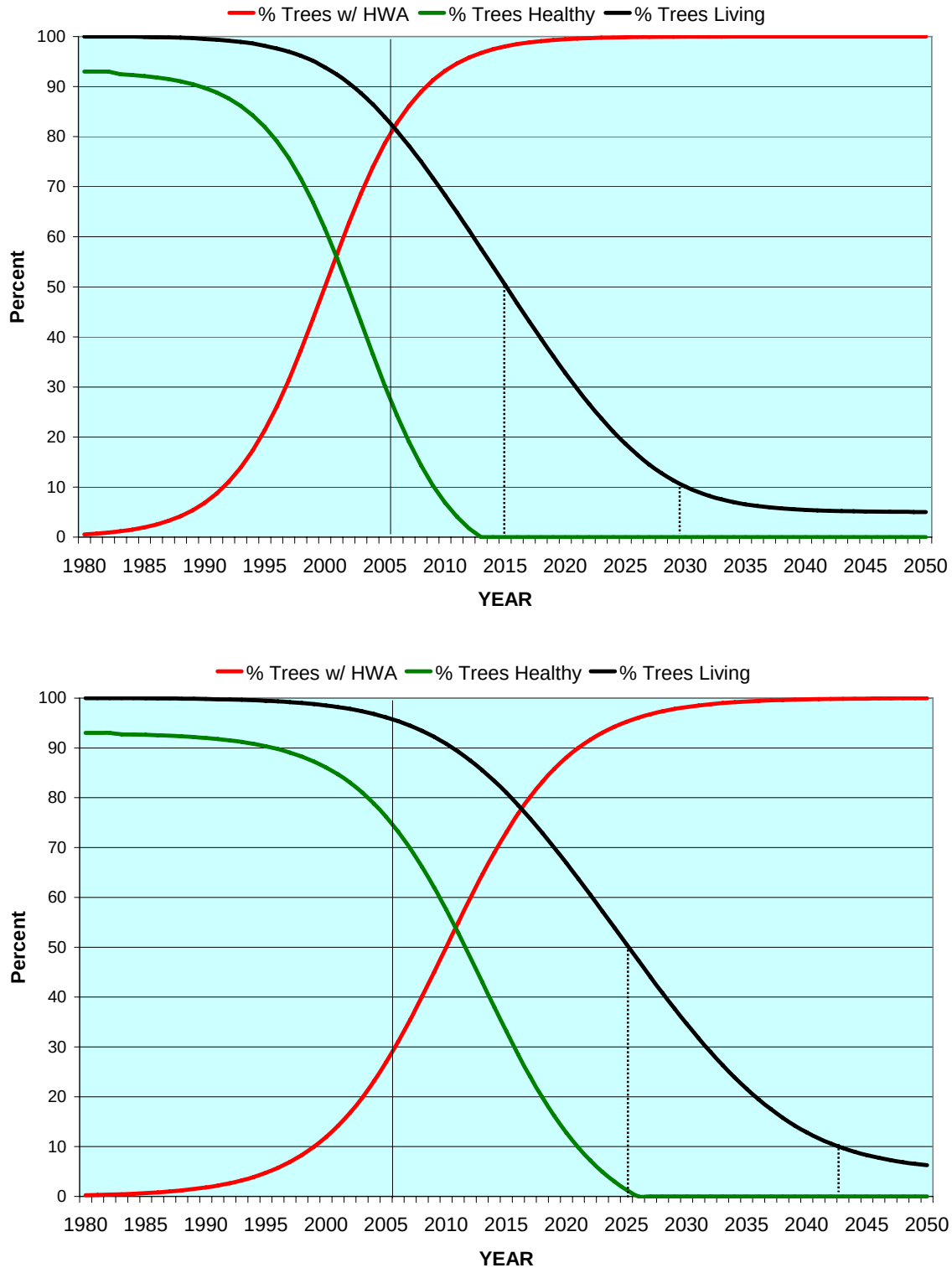

Figure 3. Mathematical models of the spread of HWA infestations throughout the park, and subsequent decline and mortality of hemlock trees. The upper graph is based on park data; the lower graph uses a lower (more conservative) estimate of the rate of spread of HWA. (See Forecasting Hemlock Decline in text for more detailed explanation.)

Post-treatment assessments also include collecting branches from the lower and upper crowns of treated trees, and analyzing them for imidacloprid and its derivatives, HWA and EHS infestation levels, and new twig production. Trees are climbed to collect the upper crown branches from heights of approximately 50 – 75 feet above ground. The following tree climbers collected upper crown branch samples in 2005: Mr. Brad Onken and Mr. Tom Elliot of the USDA Forest Service (Morgantown, WV), Mr. Ken Gooch of the Massachusetts Department of Conservation and Recreation, and Richard Evans (NPS). Analysis of branch samples for imidacloprid and its derivatives was completed by Dr. Anthony Legalante of the Department of Chemistry at Villanova University.

Analysis of the existing data for this project is underway, but not completed. Informal review of the data indicates that imidacloprid reached upper crown branches as well as lower crown branches. However, imidacloprid and its derivatives were not taken up as readily as expected with either of the soil treatment methods. Imidacloprid and its derivatives were most commonly found in trees that had received stem injections, rather than soil treatments. Sporadic or inconsistent uptake of imidacloprid by trees receiving soil treatments may be the result of soil and/or weather conditions or the particular location of a soil drench or soil injection relative to the root structure of each hemlock tree.

Hazardous Tree Removal at Raymondskill

From mid-July until early October, 2005, the parking lots, trails and grounds surrounding Raymondskill Falls unfortunately needed to be closed because of hazards from dead and dying trees. A total of 88 hazardous trees were identified and marked for removal; 72 of these (82%) were hemlock trees, seven were white pines, and six were oaks. The median diameter (at breast height) of these trees was about 16 inches. A contractor (Energy Engineering & Controls, Inc., of Center Valley, PA) was hired to cut-down and limb the hazardous trees. Because of the steep, rugged terrain (vulnerability to erosion), limited access for heavy equipment, and as recommended by experienced foresters, downed trees were left on site.

Objectives of this work were to:

1. Fell the trees to remove the hazardous conditions, without damaging park infrastructure (the restroom, trails, and handrails).
2. Minimize soil disturbance and damage to trees not marked for cutting.
3. Leave site conditions that will prevent or minimize erosion on steep slopes following cutting.
4. Leave site conditions that will facilitate native tree and plant regeneration following cutting, without creating a fire hazard.

Funding has been obtained (NER Science grant) and planning is underway to restore the forest at this site following this unfortunate but necessary removal of hazardous trees. The objectives of the reforestation project at Raymondskill Falls are to:

1. Prevent invasions of alien plants.
2. Foster regeneration of hemlocks and other desired tree species.
3. Minimize erosion.
4. Inform and educate the public.

Public Information & Technical Assistance

- Presentation titled "Impacts of hemlock decline at Delaware Water Gap National Recreation Area" at the Third Symposium on Hemlock Woolly Adelgid in the Eastern United States. February 1-3, 2005. Asheville, North Carolina.
- Provided recommendations to maintain the health of the mixed hemlock forest that is part of the "Sacred Ground" immediately adjacent to the Flight 93 crash location at Flight 93 National Memorial (FLNI) (part of a team to evaluate natural resource issues at this newly created park unit; Evans et al. 2005).
- Organized two, two-hour sessions on the Collaborative Environmental Monitoring and Research Initiative (CEMRI) at the 2005 George Wright Society meeting in Philadelphia, one of which focused on park hemlock forests. Presentation titled "Hemlock forest decline at Delaware Water Gap National Recreation Area: Research, Monitoring, and Management."
- Assisted with a George Wright Society field trip to the park (tour of Dingmans Falls).
- Led a "tour" of Childs Park for group of federal land managers (organized by J. Gasser, NPS Office of Policy).
- Led a Keystone College teacher's class "tour" of Raymondskill.
- Site visit and shared information with Mr. Richard Schulhof (Deputy Director of the Arnold Arboretum of Harvard University).

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PURPLE LOOSESTRIFE
(*LYTHRUM SALICARIA*)

BIOCONTROL PROGRAM

Prepared by

Jeffrey Shreiner
Biologist

ABSTRACT

Purple loosestrife is an aggressive alien weed that degrades wetland plant communities and wildlife habitat. The main goals of the park's control program are to restore severely degraded sites and to reduce the rate of spread to new sites. We plan to accomplish this by a program of early detection, biological control (treatment and monitoring), and education/outreach.

Three groups of biological control organisms have been released in the park. *Galerucella* beetles feed on young shoots and foliage; *Hylobius* beetles are root-borers; and *Nanophyes* beetles are flower-feeders.

This year, we continued monitoring of release sites to check for establishment and effectiveness of *Galerucella* beetles. Persistence of *Galerucella* populations from releases made in 1999 and 2000 was observed at six of eight sites.

Control was achieved at two of the eight sites, where purple loosestrife cover is now less than 10% and insect damage to remaining plants moderate to severe. One of these sites, Old Dingmans Upper Pond, is a beaver pond – marsh complex draining to the Delaware River in Sandyston Township. The other site, Montague Rivershore, is a wet meadow located opposite Milford Beach.

Dispersal of *Galerucella* along the Delaware River from four previous release sites was investigated and confirmed. We observed widespread dispersal north of the Walpack Bend and patchy dispersal to the south.

Results to date are consistent with those seen at sites in Pennsylvania and New Jersey, where *Galerucella* have dispersed to new areas and control achieved at release sites in 5-10 years.

Subject to availability, additional *Hylobius* and *Nanophyes* beetles will be purchased and released in future years.

GOALS AND METHODS OF THE PROGRAM

Purple loosestrife *(Lythrum salicaria)* is a noxious weed that invades wetlands, especially following disturbance. It can quickly "take over," replacing native species that provide food and cover for wildlife. Large, spreading infestations may threaten endangered plants and animals.

Purple loosestrife is established in the park and we cannot expect to eradicate it. Our main goals are to restore severely degraded sites and to reduce the rate of spread to new sites. We plan to accomplish this by a program of early detection, treatment and monitoring, and education/outreach.

Biological control agents will be used to treat moderately to severely infested sites. Several species of leaf-eating (*Galerucella spp*.), root-boring *(Hylobius sp*.), and flower-feeding (*Nanophyes sp*.) beetles have been carefully screened and approved for field release by the U.S. Department of Agriculture. These herbivores control their plant host by reducing plant vigor and seed production. Over a five to ten year period, native species return as purple loosestrife declines.

All sites treated with biological controls will be monitored annually for up to five years to determine success or failure in establishing viable beetle populations. Establishment monitoring will follow protocols developed by biologists at NJ Department of Agriculture (NJDA) Beneficial Insects Lab (Scudder, et. al. 2000). Visual inspections of loosestrife shoots are conducted in spring or early summer. Observers look for individuals of each species and life stage (egg, larva, adult) and for feeding damage on leaves and shoots.

At a few sites, additional monitoring will document long-term changes to the wetland plant communities. Long-term monitoring will utilize the revised "Purple Loosestrife Monitoring Protocol" developed by Dr. Bernd Blossey of Cornell University (Blossey 1997). The Cornell protocol employs sampling of square-meter plots to measure the abundance of beetles, the abundance of purple loosestrife, and the extent of feeding damage to individual plants. Monitoring is done twice a year, in spring and late summer. Park staff members have received training in these techniques.

An extensive surveillance program (currently unfunded) will provide early warning of new infestations, which will be treated with the herbicide Rodeo. Rodeo is a glyphosate herbicide formulated for use in and near water and wetlands. Light infestations can be successfully controlled, and sometimes eradicated, by aggressive use of herbicide.

RESULTS AND DISCUSSION

Establishment and Effectiveness Monitoring

This year we monitored eight release sites for the persistence of *Galerucella* beetles and their effectiveness controlling the host plant. Field visits were made in late June and early July, when *Galerucella* damage from both the spring generation (overwintered adults) and summer generation (recently hatched larvae) would be evident. Purple loosestrife plants located along wandering transects were visually inspected for target organisms and feeding damage to leaves and shoots. Each organism or life-stage was recorded as present or absent. Populations of *Galerucella* persist at six of the eight sites.

The effectiveness of previous releases was assessed by estimating the abundance of purple loosestrife and the level of feeding damage, then rating each site as ‘control achieved’ or not achieved. Feeding damage was ranked on a scale of one (little or no damage) to five (damage severe and extensive). Purple loosestrife abundance was ranked as low, moderate, or high, based on percent cover.

A site was rated as 'control achieved' when purple loosestrife abundance was low (no greater than 10% cover) and feeding damage to remaining plants was moderate or heavy. We found that purple loosestrife is currently under control at two of the eight release sites monitored this year (Table 1).

Table 1. Results of *Galerucella* Establishment and Effectiveness Monitoring, Summer 2005.

Release Site	Survey Date	*Galerucella* Recovered?	Purple Loosestrife Abundance	Feeding Damage	Control Achieved?	Comments
Birchenough	6/23/05	Yes	High	moderate	No	Damage widespread, including wet meadow; larval damage to growing tips widespread.
Bushkill Access	7/12/05	no	High	little/none	No	Lythrum cover >90%; Damage limited to rivershore.
Conashaugh Corner	6/29/05	yes	High	evident	No	
Flat Brook Pompey	7/14/05	no	High	little/none	No	Heavy deer browse; no insect damage
Montague Rivershore	6/28/05	yes	Moderate	evident	Yes	Lythrum cover near 10%
Old Dingmans	6/21/05	yes	High	moderate	No	Adult and larval feeding damage widespread; growing tips withered on most plants.
Old Dingmans Upper Pond	6/21/05	yes	Low	severe	Yes	Lythrum cover 1%; larvae feeding on growing tips
Smith Ferry Rivershore	7/14/05	yes	Moderate	little/none	No	Lythrum codominant in sedge meadow.

Old Dingmans Upper Pond remains our "poster child" for how biocontrol is supposed to work (Figure 1). This beaver pond – tussock sedge marsh was heavily infested with purple loosestrife when 4500 *Galerucella* beetles were released in 2000. Over the next three years, the beetles dispersed throughout the wetland. By 2004, damage to the loosestrife was widespread and severe. Foliage was skeletonized, plants died back, and few were able to flower. This year, loosestrife plants throughout the site were small and stunted, and the percent cover was less than 10%, meeting the management objective for successful control.

At Montague Rivershore, a wet meadow located along the Delaware River opposite Milford Beach, beetles have also established and hammer away each year at the ribbon of loosestrife which typically develops along the water's edge. Last year, feeding damage was severe and this year purple loosestrife abundance dropped to 10% in the wet meadow. Importantly, the insects survived the flood events of September 2004 and April 2005. It seems likely that good numbers of *Galerucella* overwinter here and disperse up and down river.

By contrast, no *Galerucella* were recovered this year from Bushkill Access Wetland, another emergent wetland system located near the Delaware River, where 5500 adults were released between 2000 and 2002. It was presumed that this wetland would become an important overwintering site from which beetles would disperse and attack rivershore loosestrife.

Figure 1. Photos documenting successful control of purple loosestrife at Old Dingmans Upper Pond in 2005. Note skeletonized host plants in a matrix of native grasses, sedges and forbs.

Dispersal Monitoring

This year, for the first time, we conducted a comprehensive search of the Delaware River shoreline for evidence of *Galerucella* dispersal from four previous release sites. Monitoring stations were established at 16 river access points, from Montague Rivershore (opposite Milford Beach) down river to Hialeah Picnic Area. Spacing between stations was several miles. At each station, we inspected purple loosestrife plants growing at or near the water's edge, along 50 meters of shoreline. We searched for *Galerucella* eggs, larvae, adults, and feeding damage. We found evidence of widespread *Galerucella* dispersal north of the Wallpack Bend, and patchy dispersal to the south (Figure 2).

Six Year Recap

Based on data from other release sites in New York and New Jersey, we expected to begin seeing measurable results at five to ten years following initial releases. At Great Swamp Natural Wildlife Refuge, for example, *Galerucella* released in 1995 built up sizable populations by 2000 and successfully controlled loosestrife in refuge impoundments by 2005. (source: Craig Bitler, Great Swamp NWR). Elsewhere in New Jersey, insects have been recovered at wetlands located up to five miles from the nearest release site (source: Mark Mayer, NJ Dept. of Agriculture).

To recap what we've done and the results we've seen:

What we've done

- Released a total of 115,000 *Galerucella* adults at 21 sites throughout the park: 1,880 *Hylobius* adults at 9 sites; and 2,250 *Nanophyes* adults at 4 sites, from 1999-2004.
- Monitored *Galerucella* establishment and effectiveness at various release sites each year from 2001-2005.
- Monitored *Galerucella* dispersal along the Delaware River corridor in 2005.

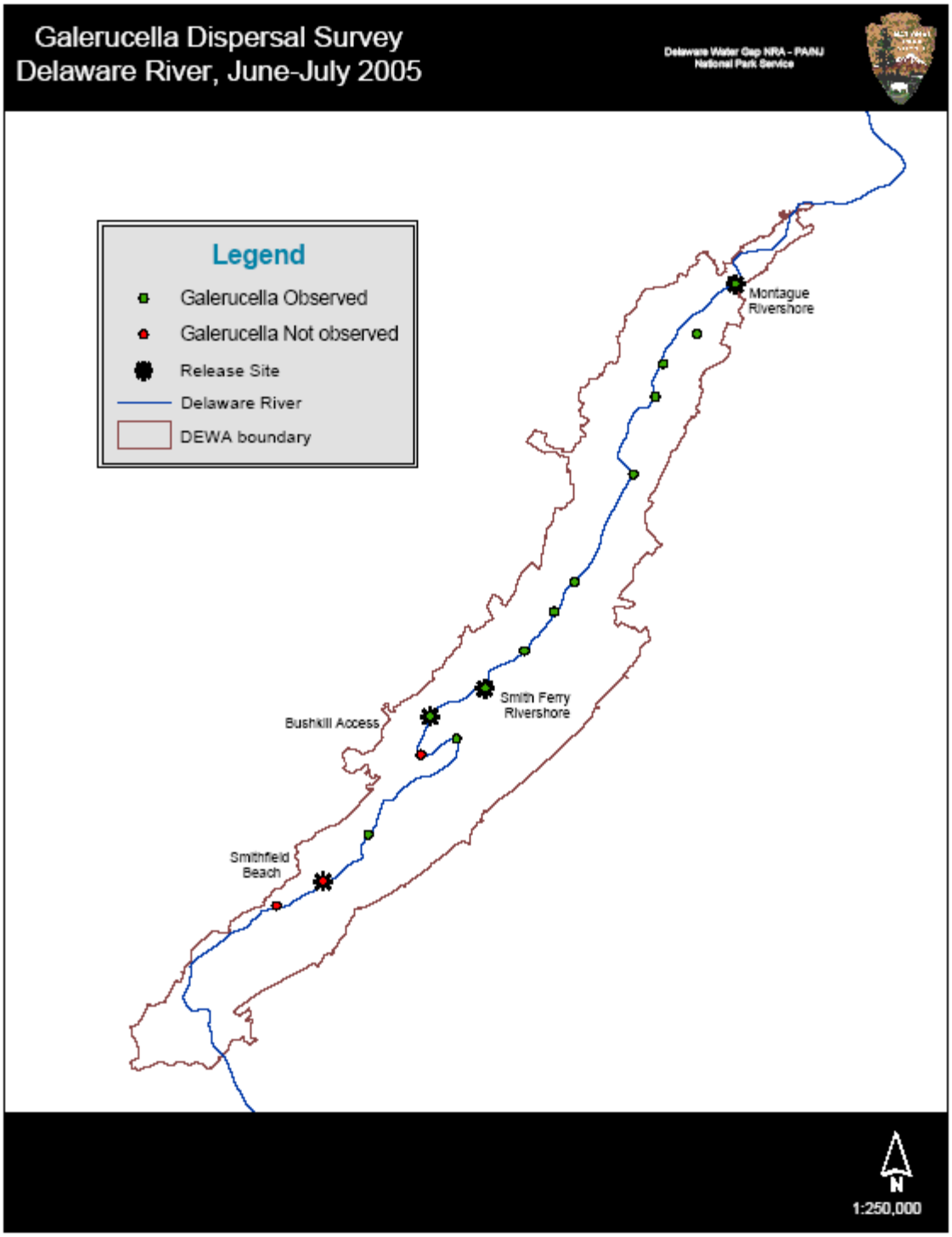

Figure 2. Galerucella Dispersal Survey

Results we've seen

- *Galerucella* populations have persisted at most sites at which substantial releases were made and for which we have data. They have spread within sites but typically are not evenly distributed. Where distribution is patchy, wetter sites or portions of sites seem to be preferred over drier areas.
- *Galerucella* have dispersed from four Delaware River release sites and occupy river shoreline habitat throughout the park. They overwinter along the River and survived severe flooding events in fall 2004 and spring 2005.
- Management objectives were achieved in 2005 at one palustrine wetland (Old Dingmans Upper Pond) and one rivershore (Montague) site. Purple loosestrife cover at these sites is estimated to be less than 10% and feeding damage to the remaining plants moderate to severe. This compares to one success story (Old Dingmans Upper Pond) in 2004.

What we don't know

- Whether *Hylobius* (root-borer) populations have established at any of the four release sites. These insects live inside loosestrife stems and roots. They are not easily observed and have not been monitored.
- Whether *Nanophyes* (flower-feeder) populations have established at any of the four release sites. Monitoring in 2004 at two sites failed to detect adults of this species. Future monitoring to document establishment is needed and is planned for 2006.
- Whether *Galerucella* have dispersed to other park wetlands, as they have along the Delaware River shore. We expect this to be true. There are a few sizeable, emergent wetlands in the park where insects have not been released and we plan to check for *Galerucella* presence next year.
- Whether management objectives achieved this year at two sites will continue to be met in 2006 and future years.
- Whether management objectives will be achieved at other release sites or along the Delaware River. We plan to continue sampling a number of release sites each year to monitor biocontrol effectiveness. We expect to achieve management control at additional sites in the next few years.

Future Plans

- Subject to availability from Cornell University, both *Hylobius* and *Nanophyes* beetles will be purchased and released in future years. Drier sites, such as wet meadows and fens, will be targeted.
- Monitoring will continue to assess long-term outcomes of the biocontrol program at sites throughout the park.
- Continued assistance from the Northeast Region Exotic Plant Management Team will be requested at sites where other invasives, such as multiflora rose and Japanese barberry, coexist with purple loosestrife and degrade key wildlife habitat.

LITERATURE CITED

Blossey, Bernd. 1997. Purple Loosestrife Monitoring Protocol. Second Draft. Downloaded from the Internet.

Scudder, Thomas, Kham Vongpaseuth, Mark Mayer, Daniel Palmer and Robert Huffman. 2000. Release of *Galerucella calmariensis* and *Galerucella pusilla* (Coleoptera:Chrysomelidae) to Control Purple Loosestrife, *Lythrum salicaria*. 2000 report.

Shreiner, Jeffrey. 2001. Biological Control of the Noxious Weed: Purple Loosestrife *in* Annual Report 2001, Research and Resource Planning, Delaware Water Gap National Recreation Area.

DATASETS

Electronic files for the purple loosestrife control project currently reside on the Division of Research & Resource Planning network server. Key files include the following:

//Inpdewasheridan/dewa/

- /Databases/ folder: **Lythrum biocontrol_XP.mdb**, MSAccess database. Stores data pertaining to site locations, releases, monitoring, and photo points. Updated annually.
- /shapes_NAD83/ folder: **loosestrife_biocontrol_83.shp**
  Thematic point coverages showing locations of biocontrol release sites.

//Inpdewasheridan/users/@Jeff/exotics/Lythrum biocontrol/

- /Maps/ folder: contains 3-map set of release sites in JPEG format.

INTEGRATED PEST MANAGEMENT
Non-Native Species Control
West Nile Virus Monitoring

Prepared by

Larry Hilaire
Wildlife Biologist
Park IPM Coordinator

A Fecon bull hog attached to a track machine was used to open up NJ fields heavily infested with invasive exotic autumn olive (*Elaeagnus umbellata*).

ABSTRACT

Integrated Pest Management (IPM) is a process one follows to determine whether a pest problem exists, and decide what integrated approach can be used to either eliminate or reduce the problem to tolerable levels.

The NPS policy establishing IPM as the preferred method for managing pest species evolved from previous policies, executive orders, and a presidential memorandum (August 2, 1979). In accordance with NPS Management Policies 2001 (4.4.5.2):

> *The Service conducts an integrated pest management (IPM) program to reduce risks to the public, park resources, and the environment from pests and pest-related management strategies. IPM is a decision-making process that coordinates knowledge of pest biology, the environment, and available technology to prevent unacceptable levels of pest damage, by cost-effective means, while posing the least possible risk to people, resources, and the environment.*
>
> *The Service, and each park unit, will use an IPM approach to address pest issues. Proposed pest management activities must be conducted according to the IPM process prescribed in Director's Order #77-7: Integrated Pest Management. Pest issues will be reviewed on a case-by-case basis. Controversial issues, or those that have potential to negatively impact the environment, must be addressed through established planning procedures and be included in an approved park management or IPM plan. IPM procedures will be used to determine when to implement pest management actions, and which combination of strategies will be most effective for each pest situation.*
>
> *Under the Service's IPM program, all pesticide use on lands managed or regulated by the Service, whether that use was authorized or unauthorized, must be reported annually by 1) the Environmental Protection Agency; 2) the individual states in which parks are located; and 3) Director's Order #30A: Hazardous and Solid Waste Management, Director's Order #77-1: Wetland Protection, and Director's Order 77-7.*

IPM integrates compatible techniques to maintain pest damage below an unacceptable injury level while providing protection from threats to public health and safety and to the natural environment. IPM makes maximum use of such naturally occurring pest population regulating factors as weather, predators, parasites, and pathogens. It also utilizes genetically resistant hosts and environmental modification, as well as various physical, cultural, biological, and chemical control techniques.

METHODS

Following these directives, in the past year, we have completed the following:

- Assistance, coordination and direction were provided on an as-needed basis for the Northeast Region's Exotic Plant Management Team (EPMT) based at DEWA. This

included serving as the contracting officer's representative for contracted field clearing near Walpack Center.

- Native grass seeds were harvested for use in the park with the assistance of Matt Bennett, Student Conservation Association (SCA) intern.
- Revised the park's plan for dealing with the threat from the West Nile virus (WNV) which was approved by the NPS Regional office, the Regional IPM Coordinator, and the park superintendent. This was in coordination with all five (park) counties.
- Investigated and advised on pest problems including mice, ants, powderpost beetles and wasps.
- Updated, tracked, and tallied pesticide use proposals and use within the park, including park divisions, cooperators, and farmer permittees.
- Updated and compiled pesticide labels and pesticide *Material Safety Data Sheets* for park use.
- Compliance (NEPA) assistance was provided as needed for park projects with the potential to affect IPM objectives including the Columbia Gasline right-of-way work.

RESULTS

Invasive Exotic Species

In an effort to achieve park and servicewide commitments under GPRA Goal Ia1, Executive Order 13148 (Clinton 2000), and other enabling legislation, the EPMT treated an estimated 220 acres (gross) at 5 different sites throughout the park to control twelve separate invasive species. This represents an increase from the 83.3 acres treated in 2004, the EPMT's first year of operation. Species controlled include autumn olive (*Elaeagnus umbellata*), tree-of-heaven (*Ailanthus altissima*), multiflora rose (*Rosa multiflora*), Japanese knotweed (*Polygonum cuspidatum*), purple loosestrife (*Lythrum salicaria*), bush honeysuckles (*Lonicera spp*.), Japanese hops (*Humulus japonicus*), etc. Treated areas include Minisink Island, Walpack Center, three dam sites, Loch Lomond fields, and a small area near Camp Kittatinny.

The EPMT contracted land-clearing work for two fields near Walpack Center, NJ as part of a demonstration project to show how overgrown fields of invasive exotic autumn olive (*Elaeagnus umbellata*) can be effectively controlled. Additionally, a farmer cooperator cleared a number of fields of autumn olive at the former Lennington farm on Old Mine Dirt Rd. in NJ. Other farmer permittees also assisted with mowing invasive exotic species on fields designated as "wildlife lands" as part of their agricultural special use permits in both PA and NJ. Utilities Forestry Services, Inc., contracted with funding from the NER EPMT, completed a demonstration exotic plant clearing operation near Walpack Center, NJ. (above).

Implementation
Assistance, coordination and direction were provided on an as-needed basis for the EPMT based at DEWA. Priority treatment sites within DEWA were compiled along with GIS maps of each area for use by the EPMT.


Native grass seed was harvested for future restoration work using the Northeast Region Exotic Plant Management Team's seed stripper in October 2005.

Restoration
Native big bluestem, little bluestem, switchgrass, Indian grass and mixed forb seeds were harvested for use in the park with the assistance of SCA intern Matt Bennett and equipment purchased by the NER EPMT. This seed will be used to stabilize former croplands on Minisink Island, NJ and additional sites in Pennsylvania (see *Land-based Resources: Open Space and Agricultural Fields/Agricultural Lands Monitoring*).

Additionally, potential sites for American chestnut (*Castanea dentata*) restoration are being documented and added to a GIS layer. These sites are existing sprouts of one-hundred percent American chestnut trees and will be included in a proposal to re-establish a backcrossed, blight-resistant cultivar within the park. The backcrossed cultivar carries resistance to the chestnut blight and yet maintains the phenotype of the American chestnut.

One of a number of American chestnut root sprouts at Raymondskill Falls (PA) (right). Chestnut blight killed billions of chestnut trees in the 1900's. The blight does not affect the roots however, and when light becomes available (here because of a decline in the overstory hemlock stand), the chestnut root sprouts grow rapidly. Eventually they too will be girdled by the chestnut blight, and more sprouts will appear.

West Nile Virus/Mosquitoes

The West Nile virus (WNV) has been spreading from the New York City area where it was first identified in 1999, and it has now been confirmed in 48 states, the District of Columbia, and as far west as California. During 2005, a total of 2,525 human cases of WNV infection were reported in the U.S. including 6 in New Jersey and 25 in Pennsylvania. Only Hawaii and Alaska were free of West Nile virus activity in 2005. No positive mosquitoes or dead birds were found in or immediately adjacent to the park. Pennsylvania, however, did not test mosquito samples within the park this year. The closest documented WNV activity to the park was a finding of two positive mosquito pools near Belvidere, NJ. According to Christine Musa, Warren County Mosquito Commission, "*… 2005 was so dry by mid-season everything dried up. If we had another year similar to 2003 with water everywhere and a bumper crop of Culex mosquitoes, things would likely be very different. This disease is still unfolding though and there are not established patterns to go by*."

A plan for dealing with West Nile virus for the year 2005 was revised from the previous plans approved by the NPS Regional IPM Coordinator and DEWA superintendent, in coordination with Pike, Monroe, Northampton, Sussex and Warren counties. The park's WNV plan relies on surveillance by cooperating counties and addresses the possibility of treating (i.e. application of mosquito larvicide and/or adulticide) areas of the park and under what circumstances. Initially, Section 7 consultation was requested and received by the US Fish & Wildlife Service, NJ and PA, in regard to possible treatment interventions and potential effects on endangered species in 2000.

Other Pests

Products were reviewed and approved for the control of ants and wasps for park cooperators and other park divisions.

Invasive Exotic Forest Pests

Park neighbors and cooperators were contacted in order to stop the potential spread of invasive exotic forest pests including the emerald ash borer and the Asian longhorn beetle. Both could be unknowingly transported to the park from infested areas on (contaminated) firewood.

The Emerald ash borer probably arrived in the United States on solid wood packing material carried in cargo ships or airplanes originating in its native Asia. Emerald ash borer is established in Windsor, Ontario, was found in Ohio in 2003 and in northern Indiana in 2004. Since its discovery, Emerald ash borer has killed at least 8 to 10 million ash trees in Michigan, Ohio and Indiana. Most of the devastation is in southeastern Michigan.

Native to parts of Asia, the Asian longhorned beetle is believed to have arrived in North America in the wooden packing material used in cargo shipments from China. Isolated Asian longhorned beetle infestations have been discovered in Brooklyn and Amityville, New York, and in Chicago, Illinois. Trees favored by the Asian longhorned beetle are predominantly maples, but infestations have also been discovered in horse chestnuts, poplars, willows, elms, mulberries and black locusts. Currently there is no known chemical or biological defense against the Asian longhorned beetle, and in North America, they have few natural predators. In cases of infestation, the affected trees are cut down and the wood destroyed.

Gypsy moths were prevalent in areas of the counties surrounding the park, but little or no damage was observed within the park.

Pesticide Use

Proposals for the use of pesticides by park employees, cooperators (Pocono Environmental Education Center, Dingmans Campground, Met-Ed and Columbia Gas right-of-way work), and farmer permittees were submitted for approval to WASO through the National Park Service's Integrated Pest Management System database. Park pesticide use proposals and logs were assembled, maintained, and documented. Frequent consultations were also held with the regional IPM coordinator and on occasion with the WASO coordinator.

Pesticide labels were updated and compiled, and are kept in a binder in the Agricultural Leasing Program office. This is a requirement for the PA applicator's and business licensing. Because the park is not a private entity and uses pesticides, we are required by Pennsylvania to maintain a Pesticide Application Public/Business License (# BU5867, exp12/31/05). Any employee who becomes certified as a non-private (commercial) applicator will fall under this license in Pennsylvania. Pennsylvania certification is maintained for right-of-way and for parks and schools categories.

LAND-BASED RESOURCES:
OPEN SPACE and AGRICULTURAL FIELDS

By

Larry Hilaire
Wildlife Biologist
DEWA Agricultural Leasing Program

No-till farming, a soil conservation practice required in the park, helps preserve topsoil by leaving previous years' crop residue on the soil surface.

ABSTRACT

Agriculture and open space in the park: why we do what we do.

Agriculture is tightly interwoven into the historical fabric of Delaware Water Gap National Recreation Area (DEWA). Farming began with the Lenni Lenape (Munsi group) sometime between 900 and 1300 A.D., with a variety of crops like corn, beans, squash, sunflowers and tobacco. Farming continued with European settlement in the valley through the past 250 years up to the present day. Today, agriculture continues in the park for a number of reasons as outlined in the park's General Management Plan: (1) to maintain open space - as the park does not have the personnel nor the equipment to do so on its own; (2) to maintain the (historical) cultural landscape; and (3) to benefit wildlife by providing a diversity of habitats, which in turn helps provide for recreation called for in the park's enabling legislation (i.e. bird watching, hunting, and other activities).

NPS Management Policies (8.6.7) also support such use: "…Agricultural uses and activities are authorized in parks in accordance with the direction provided by a park's enabling legislation and general management plan." Furthermore, "In general, agricultural activities should be conducted in accordance with accepted, best management practices. Agricultural activities will be allowed if they do not result in unacceptable impacts to park resources, values, or purposes; they conform to activities that occurred during the historic period; they are authorized by the park's enabling legislation; or … they contribute to the maintenance of a cultural landscape."

Vandals damaged a farm tractor parked overnight near a farm field in early June.

The park's GMP also explains: "…the scene that appears today is the result of more than 200 years of human use, including farming…and if some active management is not undertaken, then much of the area will eventually return to mature forest, with the resulting loss of the scenic and historic mix of open land and forest." The GMP further explains that DEWA is divided into four management zones: natural, historic,

development, and special use. The 'natural zone' is the largest of these and is divided into two subzones, outstanding natural features (16,838 acres) and resource management (38,704 acres). The resource management subzone includes agricultural land, forests, and natural areas. The GMP states that "the combination of features in this subzone leads to the scenic diversity of the recreation area, and landscape management programs will be undertaken to enhance scenic diversity, wildlife habitat and natural and man-made systems." The resource management subzone makes up 55.6% of DEWA. A management goal stated in the GMP is to "manage the resource management subzone to maintain approximately 20% open land, 40% productive forest, and 40% maturing forest," and "management techniques will include farming and tree cutting." A further recommendation states that "…existing open areas (not including wetlands) remain open, and that additional lands that used to be open in the last 20 years or so be returned to that appearance." NPS Management Policies 2001 further state that "…landscape and vegetation conditions altered by human activity may be manipulated where the park management plan provides for restoring the lands to a natural condition." Abandoned farm fields, in many cases overrun with invasive exotic (brushy) plant species, are being targeted for restoration with native grasses and forbs, with the intent of maintaining them as open space.

METHODS

In order to maintain and restore open space in the park, this year we:

- Managed 2,700 acres of parkland by farming and an additional 1,000+ acres of open space for wildlife.
- Monitored fertilizer, pesticide recommendations, and field scouting with the assistance of a crop management association (CMA).
- Monitored compliance with all 20 agricultural permits including checking for erosion, adequate field and riparian buffers, and any obvious animal damage.
- Helped to coordinate flood damage mitigation in farm fields and access roads.
- Coordinated seasonal mowing requirements by farmer permittees, with more acres done this year than last (weather was more favorable).
- Planted one-third of Minisink Island in a native grass and forb mix.
- Completed ongoing historic orchard preservation work that included pruning and fertilizing the historic Roberts Farm orchard.
- Education and outreach was provided to other parks on restoring native grasses and managing park resources with cooperators. Presented paper and poster at George Wright Society meeting in Philadelphia.
- An open space database was constructed for monitoring and managing open space areas in the park.
- Compliance (NEPA) assistance was provided as needed for park projects with the potential to affect agricultural or wildlife fields.

RESULTS

Agriculture

Agricultural permittees managed 2,700 acres of parkland by farming and an additional 1,000+ by mowing. Because of flooding in early April, planting was delayed, many fields were left with new alluvial deposits and debris, and as a result, the harvest was likewise delayed. No-till farming practices helped reduce the total amount of potential damage however, with organic field residue helping to retain topsoil in DEWA's sandy river bottom soils.

Managing Agriculture in DEWA

Because we do not want to degrade other park resources (natural, historical, and cultural) with agriculture, other park divisions and outside agencies are consulted for their recommendations on best management practices before Agricultural Special Use Permits (SUP) (leases) are prepared or revised. These include park rangers, the park archeologist, other resource personnel familiar with wetlands, riparian areas, and rare, threatened and endangered species. All consultations may include separate, on-site visits. Outside consulting agencies may include county conservation board members, state wildlife agencies, and the U.S. Fish and Wildlife Service. In addition, the Natural Resource Conservation Service (NRCS), formerly known as the Soil Conservation Service, is always consulted and prepares a *Conservation Plan* for each tract. A *Conservation Plan* is included as a requirement of the permit, and addresses best management practices (BMPs) to control soil loss. BMPs may include adding or expanding riparian buffers, contour strips, hedgerows and field borders and reviewing soil types, cultivation methods, crop rotations, etc. The *Conservation Plan* is also a prerequisite requirement of farmer permittees for enrollment in federal (i.e. U.S. Department of Agriculture and Farm Services Agency) agricultural subsidy programs.

The produce stand (above) at Cria Cradle farm (a.k.a. "Wheat Plains" farm) provided park visitors with fresh sweet corn, assorted vegetables, pumpkins and alpaca products this year. "Cria" is the term used for a baby alpaca.

Crop Rotations/Small Grain Acreage

In 2005, up to 20% of cropland was either rotated to a small grain crop (mainly oats) or left fallow in fields usually planted with corn. It is not considered a good management practice for soil health to consistently plant the same crop (corn) year after year. Certain weeds and insect pests can adapt to fields where there is predictability in crops - requiring the use of more herbicides (to which weeds can develop a resistance). It is best to disrupt weed and insect cycles by planting a variety of crops (small grains or hay) every few years. Rotating crops also allows the ground to "rest." Unfortunately, our valley is ideally adapted for corn, and other crops are unpredictable due to heavy fog in the spring

and summer, which contributes to both fungal diseases in crops and the inability to properly dry hay. Our farmers have adapted by planting oats which they don't harvest (because it's not cost-effective to do so). Recently, the park has classified soybeans as a small grain rotation. Previously they were not classified as such because of the minimal amount of protective residue they leave on the fields post harvest. Now, however, most of the farmers are using no-till methods, which leave an abundance of crop residue on the fields, allowing for a rotation of soybeans.

Planting soybeans one year allows for the decreased input of nitrogen fertilizer the following year, because of the plant's nitrogen-fixing ability. The nitrogen-fixing nodules of the legume slowly decay the following year, providing nitrogen to the subsequent (corn) crop.

Herbicides, Fertilizer, and Crop Management Associations

The use of herbicides associated with agricultural SUP's is restricted by the NPS, and is handled through two venues: the first is through the NPS' servicewide pesticide approval system (see Integrated Pest Management/Pesticide Use), and the second is through crop management associations (CMA). CMA's are organizations set up to provide farmers with the information they need when deciding which herbicides to use, if any, and on what fields. CMA's also help to determine, through soil testing, how much lime and fertilizer are needed to grow crops. CMA's scout the crops throughout the growing season, determining what weeds are present in what fields, what herbicide is most cost effective to use for control (if any), and which field(s) need control. By recommending only what is necessary, CMA's help to reduce the amount of fertilizers and herbicides used in the park. This helps water and soil quality by avoiding product buildup in the soil, and by limiting use, prevents products from leaching into the river. Farmers are required to enroll their cropland acreage and pay an extra $6.00 to 11.00 per acre of cropland for CMA services. Crop Production Services in Florida, NY provided CMA services to farmers in the park in 2005. Sadly, this year's crop scout, Jeremy DeBlock, was killed in an accident near his home this past summer. He was reliable, enthusiastic, a good worker, and the farmers enjoyed working with him.

Agricultural Lands Monitoring

Agricultural fields and wildlife fields associated with agricultural leases were monitored as outlined in each of the special use permits. Monitoring was done to ensure compliance with lease requirements, to check for erosion, and to ensure adequate field and riparian buffers. Additional assistance was provided by CMA representatives (see above, *Herbicides, Fertilizer, and Crop Management Associations*).

A park open space database was constructed for monitoring and managing open space areas in the park. Funding was provided by the Eastern Rivers and Mountains Inventory and Monitoring network. The database will be

populated in the upcoming year. Marlyn Shaffer spraying the former crop fields on Minisink Island. (above)

The Minisink Island permit was not renewed by the farmer permittee and stabilization planting was started on the fallow fields with the assistance of the Northeast Region's Exotic Plant Management Team (EPMT), the U.S. Fish and Wildlife Service, a cooperating farmer permittee (Marlyn Shaffer), the park's fire officer and crew, and park administration. The EPMT paid for herbicide spraying of the fields, Mr. Shaffer sprayed and lightly disked the fields, the USFWS lent equipment, and the park administration provided the seed. One-third of the island was planted in a native grass and forb mix before the weather and timing temporarily prevented the completion the project. The remainder of the island should be planted in the late winter or early spring of 2006.

Historic Orchard Monitoring and Restoration

In April of 2003, twenty-two apple saplings were transplanted into the Roberts farm orchard with the assistance of Special Use Permittee Leonard Pollara. Most of the saplings still appear viable in spite of a heavy infestation of apple cedar rust last year. By 2005, the transplanted saplings had grown enough that they needed to be pruned and fertilized. East Stroudsburg University intern Rick Flacco, an experienced arborist, volunteered and completed the initial pruning. Historic apple varieties are increasingly hard to find, and their preservation represents a living link to the Delaware Valley's past, including the continuing agricultural fabric and historic settlement patterns.

Two of the twenty-two transplants did not survive through 2005, although more are expected to be ready for transplant by the spring of 2006. The NPS' Olmsted Center for Landscape Preservation, various government and private individuals, and the Arnold Arboretum of Harvard University partner with DEWA on repropogating these historic apple tree varieties within the park.

East Stroudsburg University intern Rick Flacco pruning apple tree saplings in the historic Roberts Farm orchard in March 2005. The saplings are protected from deer and vole damage with exclusionary fencing (above).

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Education and Outreach

Assistance was provided to other parks with advice on agricultural SUPs and native grasses including Sleeping Bear Dunes National Lakeshore, Tumacácori National Historic Park, and the Chesapeake & Ohio Canal National Historic Park. A poster on establishing native grass stands and a presentation entitled "Managing with Park Cooperators: Agriculture, Archeology, and Natural Resources," were given at the biannual meeting of the George Wright Society in Philadelphia, March 2005.

Conclusion

The agricultural SUP program remains secure for the present, contributing to the overall park mission, the historic scene, and to open space and habitat diversity. However, the permittees are getting older, crop prices are down, and the costs associated with farming are rising, so it is unclear how much longer the permittees will be able to continue farming. This past year, more open space acres associated with agricultural SUPs were mowed because of favorable weather patterns in late summer compared to previous years. Some agricultural fields were scoured from overflowing streams and others were flooded by the river, sometimes leaving large decaying piles of corn stalks along hedgerows. Most of the fields affected, however, appeared to receive an alluvial deposit rather than losing soil.

MANAGING THREATENED & ENDANGERED SPECIES

Prepared by

Jeffrey Shreiner
Biologist

Contributor:
Allan Ambler

ABSTRACT

Three federally-listed species, bald eagle (threatened), bog turtle (threatened), and dwarf wedgemussel (endangered), inhabit the park. A fourth species, Indiana bat (endangered), may also occur here on a seasonal basis. About 130 plant and animal species of special concern to Pennsylvania or New Jersey and several rare plant communities have also been documented.

Our accomplishments this year include the following:

- Continued long-term monitoring of the park's nesting and wintering bald eagle populations;
- Completed a baseline inventory of bog turtle occurrence throughout the park;
- Managed invasive weeds at bog turtle wetlands;
- Continued monitoring nesting attempts by peregrine falcon;
- Collaborated with Federal Highways engineers on the design of a salamander tunnel system for River Road; and
- Reviewed planning documents, consulted with agencies, and prescribed mitigation and conservation measures in connection with the McDade Recreation Trail, Federal Highways Projects, New Jersey Swim Beach, Columbia Gas Pipeline Replacement Project, Excess Structures Removal Project, and additional smaller projects.

PROGRAM OBJECTIVES

Major program objectives for the management of endangered, threatened, and other special concern species are outlined in NPS-77, Natural Resource Management Guidelines:

- Inventory and monitor threatened and endangered (T&E) species - includes mapping of species' distribution, determining population size and trends, and assessing threats;
- Ensure that park operations do not adversely impact T&E species and their habitats;
- Ensure appropriate consideration of T&E species in all plans and NEPA documents;
- Manage T&E species in accordance with the Endangered Species Act and integrate actions with recovery efforts; and
- Conduct research relevant to the preservation of T&E species.

The National Park Service's Director's Challenge clearly identifies the special role of parks in managing endangered species:

> "Among the least manipulated environments in our country, the national parks serve as refuges for declining species in the changing American

> landscape… Comprehensive surveys are needed to identify and locate rare, threatened, and endangered species in parks. Protection and restoration of native plants and animals will require enhanced monitoring efforts, informed management, and collaboration with adjacent land managers and private landowners."

Park-specific goals for T&E species are addressed in the park's Strategic Plan, which reflects servicewide mission goals. Mission Goal 1 focuses on protecting, restoring, and maintaining natural and cultural resources. Long-term goals specify how we will make progress toward this goal over a five-year period. Annual Performance Plans and Accomplishment Reports track our progress each fiscal year.

For the reporting period ending September 30, 2005, the park has long-term goals relating to bald eagle and bog turtle. Our goals are to sustain a stable bald eagle population and to complete a parkwide bog turtle inventory.

RESULTS AND DISCUSSION

Bald Eagle Monitoring

Bald Eagle (federally-listed threatened; PA and NJ endangered)

Winter Monitoring

A severe ice storm in the days preceding the survey severely hampered efforts to conduct the annual monitoring of the park's wintering bald eagle population on January 9, 2005. This volunteer effort is coordinated through the National Mid-Winter Bald Eagle Survey and New Jersey Fish and Wildlife's Endangered & Nongame Species Program. The Delaware River within the park has been a standard survey route for the national survey since 1986. The survey must be conducted on the specified dates regardless of weather conditions and must use the same survey methods. In DEWA, this requires the enlistment of volunteer observers who rotate two-hour shifts at five fixed point observation sites from 0700 hours to 1700 hours. The severe ice storm resulted in closed roads, power outages, and downed trees throughout the region and prevented many of the volunteers from participating in the survey. The reduced number of volunteers forced a reduction of the survey time and locations. Nine volunteers provided coverage at four sites continuously from 0700 hours to 1100 hours. Only four bald eagles (two adults; two immatures) were recorded for the area. This low number is likely more indicative of the abbreviated survey rather than the number of eagles present.

Weather conditions on the day of the survey were relatively mild with early morning temperatures at about 29 degrees under heavy overcast and no wind. There were 3-4 inches of snow cover in the northern half of the park with 1-2 inches of snow and ice to the south. The river was ice free at the time of the survey, a factor that may also have contributed to the low counts. Higher wintering population counts are recorded when ice-cover is extensive on the Upper Delaware and the Mongaup River system, forcing wintering eagles from that area downriver to DEWA.

Nest Monitoring

Successful nesting of bald eagles in DEWA was documented for the fourth year; however, both the number of nests and number of fledged young was lower than in 2004. In 2005, successful nests in the park dropped from three to one and the number of fledged young fell from seven to one. The Walpack nest tree blew down over the winter and the eagle pair that had previously occupied it could not be located. It is not known if they successfully nested elsewhere or if they simply did not nest. The Spackmans pair began incubation in mid-March however they abandoned the nest during heavy rains that fell just at the end of the month. The pair was observed in their territory throughout the breeding season and one new, but unoccupied, nest was found. It is not known if this pair successfully nested elsewhere. The Raymondskill nest was occupied for the fourth year and one young was successfully fledged on or about July 3rd. A new nest was discovered in the vicinity of Tom's Creek however, it was not occupied. Observations of the two eagles who constructed the nest indicate that the male was fully mature but the female was likely too young to produce eggs. It was not possible to tell if the male at Tom's Creek was from one of the failed nests at Walpack or Spackmans.

Bog Turtle Inventory

Background: Bog turtle is a U.S. threatened species in severe decline throughout its range. Chief causes of this decline are believed to be the loss and degradation of wetlands, land development and habitat fragmentation, and illegal collection (both casual and commercial).

Our main stewardship goals for bog turtle are to map the parkwide distribution of the species (inventory), to assess the condition and status of our population (research), and to achieve a population status of stable or improving (long-term monitoring, management).

This year we completed a parkwide bog turtle inventory, honoring a timeline targeted by the park's Strategic Plan. The fieldwork spanned eight years, during which time we surveyed 45 discrete wetlands, including five sites from which bog turtles had been reported by previous investigators (Table 1). These old records dated back to the 1970's, when the park's first comprehensive wildlife inventories were undertaken by the New Jersey State Museum (Stein 1978).

Table 1. Timeline of Comprehensive Bog Turtle Inventory

Year	Surveyor	Number Wetlands Surveyed
2005	Jason Tesauro Environmental Consulting	5
2004-2000	Wildlife Conservation Society	24
1999	Jason Tesauro Environmental Consulting	11
1998	The Nature Conservancy	5

The completed inventory confirms that bog turtles, though rare, still occur at a few sites in the park. Colonies are isolated and believed to be small, so the long-term outlook is uncertain. Known threats include habitat degradation and fragmentation, and nest predation. Habitat threats include flooding by beavers, shading of nesting areas by trees

and shrubs, and invasion by exotic weeds such as multiflora rose or purple loosestrife. Vehicles also take their toll, especially in locations where habitat patches border park roads.

This year's fieldwork focused mainly on habitat created relatively recently from the natural breakdown of abandoned beaver dams. Part of a natural cycle to which bog turtles have accommodated, the conversion of beaver ponds to emergent wetlands, typically occurs within a decade following abandonment. Marshes and wet meadows soon develop, sometimes yielding suitable bog turtle habitat. The likelihood of finding bog turtles in these 'beaver meadows' depends on proximity to occupied habitat, on the length of time since pond draining, and on habitat quality.

The wetland surrounding park headquarters, for example, comprises a partially-drained beaver pond that presently offers marginally suitable habitat for bog turtles (Figure 1). Much of the site lacks groundwater seeps that bog turtles need for overwintering. However, the wetland borders River Road, which is slated for major rehabilitation. Since this site had not been surveyed for bog turtles, which are known to occur in several Monroe County watersheds, we felt it prudent to investigate. A combination of visual searches and live-trapping yielded snapping turtles, ribbon snakes, and northern water snakes, but failed to detect bog turtle occurrence (Tesauro 2005) (Figure 2).

Figure 1. Mucky ditch in headquarters wetland.

Figure 2. Bog turtle trap with captive northern water snake.

Peregrine Falcon Monitoring
Peregrine Falcons: (PA and NJ Endangered)

In late winter of 2005 expectations were high that the peregrine falcon pair at Mt. Minsi would nest successfully. Both the male and female were observed on the territory through the winter. The female, who had been too young to produce eggs in the two previous years, was now a full adult. Numerous reports of her aggressive defense of the territory were a good sign of her breeding readiness.

By mid-March, observers had reported courtship behavior by the male and both birds were seen checking out various nest ledges. Observers were not able to pinpoint a single

ledge that the birds seemed to prefer. By the third week in March it appeared that nesting may have begun as only one bird was observed at a time. It was presumed that the other bird was on a nest somewhere on the cliff.

Heavy rain fell on the weekend on March 26th and there were no reported observations of either bird the following week. A severe rain event on the first weekend in April resulted in significant flooding in the region and Route 611 was closed for a period of time. With the observation location at Arrow Island inaccessible, observations were not conducted in the first week of April. When monitoring commenced, the birds could not be located. By mid-April, there were only a few reported observations of a single peregrine falcon in the vicinity of the Mt. Minsi Cliffs.

Interest in volunteer monitoring waned as sightings became less frequent. Additionally, many volunteers became involved in the many other birding activities that compete for their time in the spring. Staff time necessarily shifted to flood damage assessments and other monitoring efforts. With the reduction in observations it could not be determined conclusively that the peregrine falcons had abandoned their attempt to nest on the cliffs. The closure of the cliff face to visitors remained in effect until a conclusive determination could be made. That determination came in early June when a conversation with the PA Game Commission Peregrine Falcon Nest Coordinator revealed that a pair of peregrine falcons had established a nest on a constructed nest platform at Martins Creek Power Plant. The timing of their arrival coincided with their disappearance from Mt. Minsi. The conclusion was that the pair from Mt. Minsi had moved to Martins Creek. At that time it was decided that the closure of the cliff face could be lifted.

The pair at Martins Creek successfully fledged two young in June. Typically, a breeding pair will return to the same location in subsequent breeding season once they have been successful. If the Mt. Minsi pair are the same birds that were successful at Martin's Creek then this may mean that the nesting pair has permanently abandoned the Mt. Minsi cliff face. Monitoring will be conducted in late winter and early spring of 2006 to determine if that is the case.

River Road Salamander Tunnels

Once again this year, we closed River Road to vehicular traffic on a few rainy nights in early spring. The aim is to reduce road kill of Jefferson and spotted salamanders during their annual migration to breeding ponds near park headquarters. Movement is triggered by rainy weather and typically begins in late March. After a short period of courtship, eggs are deposited and fertilized, and then individuals of both sexes return to the surrounding woods. Wood frogs, spring peepers, red-spotted newts, and American toads also benefit from the road closures.

To afford better long-term protection for these amphibian populations, we collaborated with civil engineers from the

Federal Highways Administration to design an under-the-road crossing system. The system will feature two large-diameter tunnels, each with retaining walls and fencing to direct animals toward the tunnel openings. The design was developed from similar tunnels currently in use near Amherst, MA (Jackson 2003) and Albany, NY. Both of these systems are effective and relatively inexpensive. We plan to install this system as part of upcoming repairs to River Road. Newly installed Albany, NY tunnel with wooden retaining walls (above).

Planning and Compliance

The effects of proposed projects on state and federal T&E species are considered during planning, as required by the National Environmental Policy Act. Potential effects are identified through initial screening and carefully evaluated in Environmental Assessments. Conservation measures are sometimes needed to avoid or minimize adverse effects. In these cases, consultations with the U.S. Fish & Wildlife Service and/or state agencies are undertaken to meet requirements of the Endangered Species Act and NPS Management Policies.

This year, we consulted on the following projects:

- McDade Recreational Trail – proposed realignment
- New Jersey Swim Beach – Coppermine Inn site
- Childs Park Rehabilitation
- Federal Highways Projects, including River Road and Rte. 209 Rehabilitation
- Emergency Road Paving
- Excess Structures Removal Project
- Cliff Park Trail System
- Raymondskill Falls Emergency Hazard Tree Removal
- Pocono Environmental Education Center Cabin Replacement

Conservation measures recommended for these projects include the following:

- To protect wintering bald eagles from disturbance at key foraging and night-roost sites, a time-of-year restriction on project activities within buffer areas, typically from mid-December through March.
- To protect bald eagles from disturbance when incubating eggs or feeding young, a time-of-year restriction on project activities within nesting buffers, typically from February to August.
- To protect bog turtles and other wildlife from harm by construction equipment, the installation of wildlife-friendly barriers separating key habitat from the construction zone.
- To protect wetlands and waterways, the installation of steel-backed or ‘super’ silt fencing to hold back sediments.
- To protect tree-roosting bats, a time-of-year restriction on the cutting of potential suitable roost trees, including dead/dying trees, snags with cavities, and shaggy-barked trees larger than five inches DBH.

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WILDLIFE RECREATION ISSUES
Wildlife Viewing
Hunting

Prepared by

Larry Hilaire
Wildlife Biologist

Deer fencing was erected on a four-acre portion of a prescribed burn area near Blue Mountain Lakes in NJ. The fenced and unfenced areas will become part of a monitoring program used to evaluate the impact of deer browse on forest Health and regeneration within the park.

ABSTRACT

Since the National Park Service was established in 1916 it has been entrusted by the people of the United States… *to conserve the scenery and natural and historic objects and wild life therein and to provide for the enjoyment of same in such manner…as will leave them unimpaired for future generations* (16USC 1-4).

Furthermore, when the United States Congress established the Delaware Water Gap National Recreation Area (DEWA) as a unit within the National Park Service in 1965 (Public Law 89-158), it provided some direction on what type of recreation should occur within the park's boundaries including hunting and fishing (Section 6): …*The Secretary of the Interior shall permit hunting and fishing on lands and waters under his jurisdiction within the area.…*

The park further defines its responsibilities toward fish and wildlife in its General Management Plan (1987): "*…Fish and wildlife will continue to be managed as a cooperative endeavor with New Jersey and Pennsylvania. Efforts will be made to maintain populations for recreational hunting and fishing, viewing, study, and overall ecological value…*"

Wildlife viewing, hunting, fishing, scientific studies, and wildlife education all continue within the context of recreation as directed by the park's various mandates.

METHODS

- Consultative meetings with cooperative state and federal agencies were held on issues related to park wildlife.
- Assistance was provided to cooperating state agencies for gathering wildlife data, including at check stations and in the field.
- A proposal for funding a tri-state (NY, NJ, PA) meeting on the black bear population was completed and tentatively scheduled for March 2006.
- 2005 New Jersey bear hunt was discussed and assistance was provided with data collection at the Flatbrook-Roy bear check station.
- Public inquiries correspondence concerning wildlife species and management within the park were responded to as needed.
- Compliance (NEPA) assistance was provided as needed for park projects with the potential to affect wildlife.

RESULTS

Consultation with State Agencies

In 2005, consultative meetings were held with representatives from DEWA and of the New Jersey Division of Fish and Wildlife (NJDFW). Consultative meetings are held to

fulfill NPS policy directives to consult with state agencies, and to work toward similar seasons and regulations between PA and NJ for all hunted species.

New Jersey Division of Fish and Wildlife
NPS and NJDFW agreed in principal to identify mutually beneficial research topics to help address ecosystem issues and help DEWA to eventually meet its mandate of coordinating and integrating state(s) wildlife management targets to meet the NPS vision. Continued data collection was encouraged for species inhabiting the park in order to cooperatively make good wildlife management decisions in the future.

Black Bears: NJ provided park-specific data and updates related to the NJ black bear population. Black bears were captured using cable foot snares, culvert traps and at winter den sites. All bears were ear tagged and females were radio collared. Bear hair, blood and bacteria samples were collected for analysis. Bear movement and reproduction were documented using radio telemetry.

A total of 22 bears (13 males and 9 females) were captured and tagged during NJ spring and fall research trapping sessions. Of the 22 bears tagged 6 were yearling males, 7 were yearling females, 7 were adult males and 2 were adult females. A total of 41 bears were harvested during the 2005 bear season held December 5 -10: 19 males and 22 females.

Assistance was provided in 2005 to the NJDFW at the black bear check station located at the Flatbrook-Roy Wildlife Management Area.

Deer Harvest, Zone 4: Deer population data was discussed with NJ biologists upon reviewing deer harvest data and pictures of heavy forest understory browse in NJ Deer Management Zone 4. The park is interested in defining new target goals for deer densities that would promote optimum forest health and regeneration. It was agreed that additional, ongoing research in the park concerning the deer herd's demographics, forest regeneration and post-prescribed-burn monitoring are needed to provide more data to evaluate deer pressure in NJ.

Following up on a report published by the NJ Audubon Society, "*Forest Health and Ecological Integrity Stressors and Solutions, Policy White Paper* (March 2005)," representatives from a number of organizations including the NPS visited various sites in northwestern New Jersey to examine evidence of over browsing by deer. One of these sites was in the park at Blue Mountain Lakes, where a deer exclosure was erected after a Fall 2004 prescribed burn. The exclosure protects four acres of a larger burn area, and will be used to compare deer browsing pressure in the area as it regenerates.

Pennsylvania Game Commission
A draft General Agreement (Memorandum of Understanding) was revised and submitted to the Pennsylvania Game Commission for review.

Black Bear Conference
A proposal was written for a regionwide black bear conference to include representatives from state and federal agencies within the tri-state region (PMIS #106193). The proposal is expected to be funded in time for a March 2006 meeting.

Miscellaneous Wildlife
Public and agency inquiries about park wildlife were answered, including response letters, email and telephone inquiries, etc. Assistance with NEPA compliance issues was provided as needed.

Possible fisher (*Martes pennati*) tracks were discovered in the park by Ethan Hüner, naturalist at the Pocono Environmental Education Center (PEEC). Ethan followed up with the placement of remote cameras in conjunction with an interested PEEC student, but no fishers were photographed. Fishers were reintroduced into Pennsylvania (west of the park) and in New York State in the nearby Catskills within the last decade. Because of the nearby reintroduction sites, finding one in the park would not be unusual. It would however, mark the first time in nearly a century that a fisher was documented in the area. Fisher (*Martes pennati*) photo courtesy of Oregon Fish & Wildlife Service.

EASTERN RIVERS & MOUNTAINS NETWORK
BIOTIC INVENTORIES & VITAL SIGNS PROGRAM

Prepared by

Jeffrey Shreiner
Biologist

Contributor:
Richard Evans
Ecologist

ABSTRACT

The NPS Inventory & Monitoring (I&M) Program directs all parks to acquire "a consistent set of basic data on natural resources… in order to understand the processes that maintain and preserve the national parks." The Eastern Rivers & Mountains Network (ERMN) coordinates inventory and monitoring programs for DEWA and nine other member parks. Current initiatives include multi-year efforts to complete baseline biological inventories and to develop long-term ecological monitoring ("vital signs") protocols.

Under the leadership of coordinator Matt Marshall, the network continued a four-year, three-phase initiative to develop long-term ecological monitoring programs in network parks. In Phase 2, completed this year, DEWA participated in a series of meetings and ranking exercises to produce a priority list of 15 vital signs that the network plans to develop and implement in the next three to five years. These vital signs were chosen to represent the overall health of natural resources of network parks. Seven of the vital signs relate to biological integrity, four to water, two to ecosystem process, and two more to air and climate. The complete Phase-2 report, which comprises Chapter 3 of the long-term monitoring plan, is posted on the ERMN website: (www1.nature.nps.gov/im/units/ermn/index.htm).

Inventories lay the groundwork for development of effective monitoring programs and formulation of effective management strategies. Five of 12 natural resource inventories identified by the NPS Inventory and Monitoring Program as core datasets have been acquired and five more are near completion. ERMN is coordinating this effort with cooperating agencies.

Species' inventories for DEWA are identified and prioritized for funding in the network's five-year study plan. The following tasks were accomplished this year:

- Grassland Birds Inventory: Took delivery of the final report and datasets for a breeding bird inventory of the park's managed, open fields. East Stroudsburg University, cooperator. Results document extensive use of these fields by a mix of shrubland and "edge" songbirds, including some at-risk species.
- Fishes Inventory: Acquired additional $25,000 to fund a third year of fieldwork for fishes inventory of DEWA and Upper Delaware SRR. Philadelphia Academy of Natural Sciences, cooperator.
- Wetland Birds Inventory: Completed fieldwork for a breeding bird inventory of the park's wetlands. East Stroudsburg University, cooperator. Final report due in FY 2006.
- Plant Community Inventory: Took delivery of a draft vegetation map, vegetation key, and detailed descriptions of the park's plant communities. Began fieldwork to assess map accuracy and field-test the vegetation key. The Nature Conservancy, cooperator.
- Bat Survey: Conducted a bat survey of the Cold Air Cave / Mt. Minsi talus slopes. Bat Conservation and Management, Inc., contractor.

- Bog Turtle Survey: Conducted bog turtle presence/absence surveys of potential, suitable habitat identified from environmental reviews of McDade Trail, River Road, and other projects.

GOALS AND OBJECTIVES OF THE I&M PROGRAM

The Inventory and Monitoring Program is a key component of the NPS Director's Natural Resource Challenge, a five-year action plan for resource stewardship. As explained by former Northeast Regional Director Marie Rust, "The Challenge is about assuring that we seek and have adequate scientific information to inform our management decisions… and essentially reordering NPS priorities by taking the long view and putting resource protection first." (Rust 1999)

The I&M program is administered by the NPS Natural Resource Information Division and has established five long-term goals (NPS Inventory & Monitoring website):

- To establish natural resource inventory and monitoring as standard practice;
- To inventory natural resources under NPS stewardship;
- To monitor park ecosystems to better understand their dynamic nature and condition;
- To integrate inventory and monitoring information into NPS planning and decision making; and
- To share information and form partnerships with other natural resource organizations.

ERMN, the local administrative unit of the I&M Program, comprises five “large river” parks and five historic sites. A five-year study plan establishes the following objectives for natural resource inventories and long-term ecological monitoring (ERMN Annual Report FY2004):

- Compile existing natural resources documents and datasets for conversion to NPS databases: NPSpecies, NatureBib, and Dataset Catalog.
- Document existing vertebrate animal and vascular plant species through targeted field inventories.
- Implement and maintain an integrated GIS and data management system.
- Identify ecological indicators (“vital signs”), develop protocols, and implement long-term monitoring programs.

The new ERMN website provides one-stop shopping for up-to-date information on network activities. Available for downloading are network annual reports and work plans, the vital signs Phase-1 and Phase-2 reports and final reports from network-funded inventories. URL for the homepage: www1.nature.nps.gov/im/units/ermn/index.htm

RESULTS & DISCUSSION

Vital Signs

Under the leadership of coordinator Matt Marshall, the network continued a four-year, three-phase initiative to develop long-term ecological monitoring programs in network parks. The goals of these programs are twofold:

- To determine the status and trends in selected vital signs indicating the condition of park ecosystems.
- To provide early detection of abnormal conditions in selected park resources.

The Phase-1 report, completed in FY2004, develops conceptual ecological models for three broad ecosystem types that are relevant to network parks: large rivers, tributary watersheds, and terrestrial ecosystems. The report also summarizes existing monitoring data and identifies potential vital signs. Appendices describe park resource profiles, special concern species, air quality considerations, water quality summaries, and past/present monitoring programs.

The ERMN science advisory committee met early in FY2005 to launch Phase-2, the selection and prioritization of vital signs. First, a core team of subject matter experts developed a 'short list' of 36 candidate vital signs and prepared literature reviews for each. Next, a workshop was held to review and prioritize the list based on ecological factors. Participants included the network advisory committee, park staff, and other scientists. Finally, each park ranked the vital signs by management significance.

The results, detailed in the Phase-2 report, comprise a peer-reviewed list of proposed vital signs, each ranked by priority for development and implementation by the ERMN. Ranks are based on a scale of tier-1 (=highest) to tier-3 (=lowest). The 15 highest-ranked vital signs (tier 1) are listed in Table 1. Key categories include Water Quality and Hydrology (five vital signs); Focal Plant and Animal Communities (three vital signs), Air Quality and Climate, Invasive Species, T&E Species, and Landscape Dynamics. The ranking corresponds closely with DEWA's self-identified priorities. All but one of the park's highest ranked vital signs (Visitor Use) are tier-1 priorities for our network.

Early in FY 2006, the proposed list will be submitted to the ERMN board of directors for approval. The third and final phase of planning will develop sampling designs and protocols for these vital signs. Implementation will begin in FY 2007.

Table 1. Listing of the 15 highest-ranked Vital Signs for the Easter Rivers and Mountains Network.

Category	Vital Sign	General Monitoring Objective and Typical Parameters
Air Quality	Wet and Dry Deposition	Trends in atmospheric pollutant emissions (pH; Nitrogen; Sulfur)
Weather & Climate	Weather & Climate	Climate trends (precipitation; temperature; solar radiation)
Hydrology	Surface Water Dynamics	Water quantity (discharge; flood events; ice-scour)
Water Quality	Core Water Chemistry	Trends in NPS core parameters (pH; Dissolved Oxygen; conductance; temperature)
Water Quality	Expanded Water Chemistry	Cations/anions; turbidity; organics; toxics; coliforms; etc.)
Water Quality	Aquatic Macroinvertebrates	Species richness; diversity; biotic indices of indicator groups
Invasive Species	Invasive Species Status & Trends	Status of established populations (distribution; occurrence)
Invasive Species	Invasive Species Early Detection	Detection and predictive modeling of incipient invasives
Focal Species/ Communities	Shrubland, Woodland, & Forest Communities	Plant community composition, structure and dynamics
Focal Species/ Communities	Riparian Communities	Riparian plant community composition, structure and dynamics
Focal Species/ Communities	Breeding Bird Communities	Bird community composition; structure and dynamics
At-risk Biota	T&E Species – Federal	Population status/trends of selected federal-listed species
At-risk Biota	T&E Species – State	Population status/trends of selected state-listed species
Landscape Dynamics	Land Cover and Use	Changes in and around park watershed boundaries (roads; residential development; deforestation; impervious surfaces)
Landscape Dynamics	Landscape Pattern	Changes in landscape metrics (patch size and connectivity; land cover types; etc.)

Natural Resource Datasets

All natural resource parks must possess at least a minimal compliment of resource inventory information in order to be able to effectively manage resources. Baseline inventory information has been defined in terms of 12 core datasets that include a variety of biotic and abiotic ecosystem components. Acquisition of these datasets for network parks is an ERMN priority for completion by 2010. For DEWA, six datasets are complete and three more due in 2006 (Table 2).

Table 2. Acquisition status of 12 Priority Natural Resource Datasets

Dataset	Status
Air Quality Pollutant Values	Acquired 2005
Location of Air Quality Monitoring Stations	Acquired 2004
Base Cartography	Acquired 2005
Location of Weather & Climate Monitoring Stations	In Progress, due 09/2006
Geology Report and Digital Map	Map due FY07; report planned for FY07
Natural Resource Bibliography (Naturebib)	In works; due 06/2006
Soils Report and Digital Map	In Progress
Species Inventories (Species Lists Certified)	One of 6 species lists certified; completion of all six by 2007.
Vegetation Community Report and Digital Map	In process; final due 2006
Waterbodies Location/Map	Completed 2005
Water Quality Summary	Report done 1995
Water Assessment: Impairment of Designated Use	Completed 2004

Biological Inventories

Inventory priorities for DEWA have all been funded. Five are complete or nearly so and four others are underway (Table 3). Three of these inventories are discussed in more detail below.

Table 3. DEWA Biological Inventories funded by NPS Inventory & Monitoring Program, Eastern Rivers and Mountains Network, 2000-2005.

Taxon	Status	Comments
Amphibians & Reptiles	Completed; final reports in progress	Target Species: Turtles of Special Concern; Venomous Snakes; Lizards; Stream Salamanders; Vernal Pond Amphibians
Grassland Birds	Completed	Final report: August 2005
Wetland Birds	Completed	Final report due: FY2006
Mammals – Bat Hibernaculum Survey	Completed	Survey of Mt. Minsi Talus / Cold Air Cave
Mammals – Appalachian Trail, small mammals	Completed	A.T. corridor: CT, NY, NJ, PA Final report due: FY2006
Mammals – Northern Flying Squirrel	Fieldwork 2005-2006	Parkwide Survey Final Report due: FY2007
Fishes	Fieldwork 2004-2006	Includes UPDE Final report due: FY2007
Plant Communities – Classification & Mapping	Fieldwork 2004-2006	Includes Fire / Fuels component Final report/map due: FY2006
Invertebrates – Crayfish	Fieldwork 2005	Multipark project. Final report due: FY2006

Vegetation Classification and Mapping

Objectives: The objectives of this project are to classify and map the park's plant community types and how they burn. Deliverables will include GIS datalayers (shapefiles), a final report describing each of the park's plant communities and fire-fuels models, and a technical key to the identification of vegetation types in the field.
Cooperator: The Nature Conservancy, Pennsylvania Science Office. Dr. Greg Podniesinski and Dr. Stephanie Perles, principal investigators.
NPS Key Official: John Karish, NER chief scientist; DEWA liaison: Jeffrey Shreiner.
Status: Funded in FY2002 via Amendment #1 to Cooperative Agreement No. 4560-A-0019. Project schedule revised to extend fieldwork to FY2006; project completion late in FY2006.

2005 Highlights:
Drafts of all project deliverables were reviewed by park staff. Field testing of the map and vegetation key began this year and will be completed in spring 2006. The key can be used to identify plant communities anywhere in the park, based on user assessments of site hydrology (wetland vs. upland), landscape setting (floodplain; ridgetop; etc.), and dominant plant species. Seventy plant communities have been identified and described, and all but the smallest mapped.

Based on vegetation form and structure, DEWA plant communities are divided into five main categories: forests (closed tree canopy); woodlands (open tree canopy); shrublands;

herbaceous communities (for example, old fields or little bluestem grasslands); and sparsely vegetated types (for example, talus slopes or rocky summits).

Forests comprise DEWA's largest cover type. Thirty distinct forest communities, totaling over 53,000 acres, may be grouped into five main types: dry oak and pine forests; mesic hardwoods; hemlock forest; riparian and palustrine forests; and early successional types (Figure 1).

Dry Forest Types. These types occur on dry, upland sites, typically mid to upper slopes and ridge tops. Locations include the Kittatinny and Walpack Ridges and the escarpment slopes north of Bushkill. Dry forests are dominated by oaks, hickories, and/or pine. Understory shrubs include huckleberries, blueberries, and/or mountain laurel. Communities representative of this type include dry oak – heath forest; dry oak – mixed hardwood forest, and dry pine – oak forest. Altogether, dry forest types comprise about 48% of DEWA's forested lands.

Mesic Hardwood Forest Types. These communities occur on moderately moist sites (neither excessively dry nor wet), usually at low elevations and on mid to lower slopes. Locations include valleys of the Delaware River and Flat Brook, as well as lower slopes on the Kittatinny Ridge. Dominant canopy species typically include a mix of maples, birches, basswood, red oak, and/or tuliptree. Characteristic shrubs are spicebush, witchhazel, viburnums, and raspberries.
Representative communities include Sugar Maple – Mixed Hardwood Forest; Red Oak – Mixed Hardwood Forest; and Sugar Maple – Basswood Forest. Mesic hardwood forests make up about 20% of DEWA forest.

Hemlock Forest. Two types, Eastern Hemlock Forest and Eastern Hemlock – Northern Hardwood Forest, are included. Together they cover about 6200 acres (12% of DEWA forest) and occur mainly in ravines and on north-facing slopes.

Successional and Modified Forest Types. Typically, these are young forests that have grown up on recently abandoned farmlands. They are found in valleys and other mesic sites. Representative communities include Successional Mixed Hardwood forest; Eastern White Pine – Mixed Hardwood Forest; White Pine Forest; and Eastern Red-cedar Forest.

A catch-all type, the Modified Successional Forest, occurs on highly disturbed sites. Species composition in these forests varies from site to site depending on previous land use. Canopy trees include white ash, black locust, bigtooth aspen, black walnut, black cherry, white pine, and red-cedar. Invasive herbs, shrubs and vines may be abundant in the understory. Successional types account for roughly 15% of DEWA forests.

Riparian and Palustrine Forests. These communities occur on floodplains and in wetlands. Floodplain types are associated with the Delaware River, the Flat Brook, and Bushkill Creek. Communities include Silver Maple Floodplain Forest; Sugar Maple Floodplain Forest; and Sycamore Floodplain Forest. Palustrine types are associated with depressional basins; impoundments, and beaver ponds. Communities include Red Maple

Palustrine Forest; Bottomland Oak Palustrine Forest; and Eastern Hemlock – Mixed Hardwood Palustrine Forest. Altogether, riparian and wetland forest types make up only about 5% of DEWA forest.

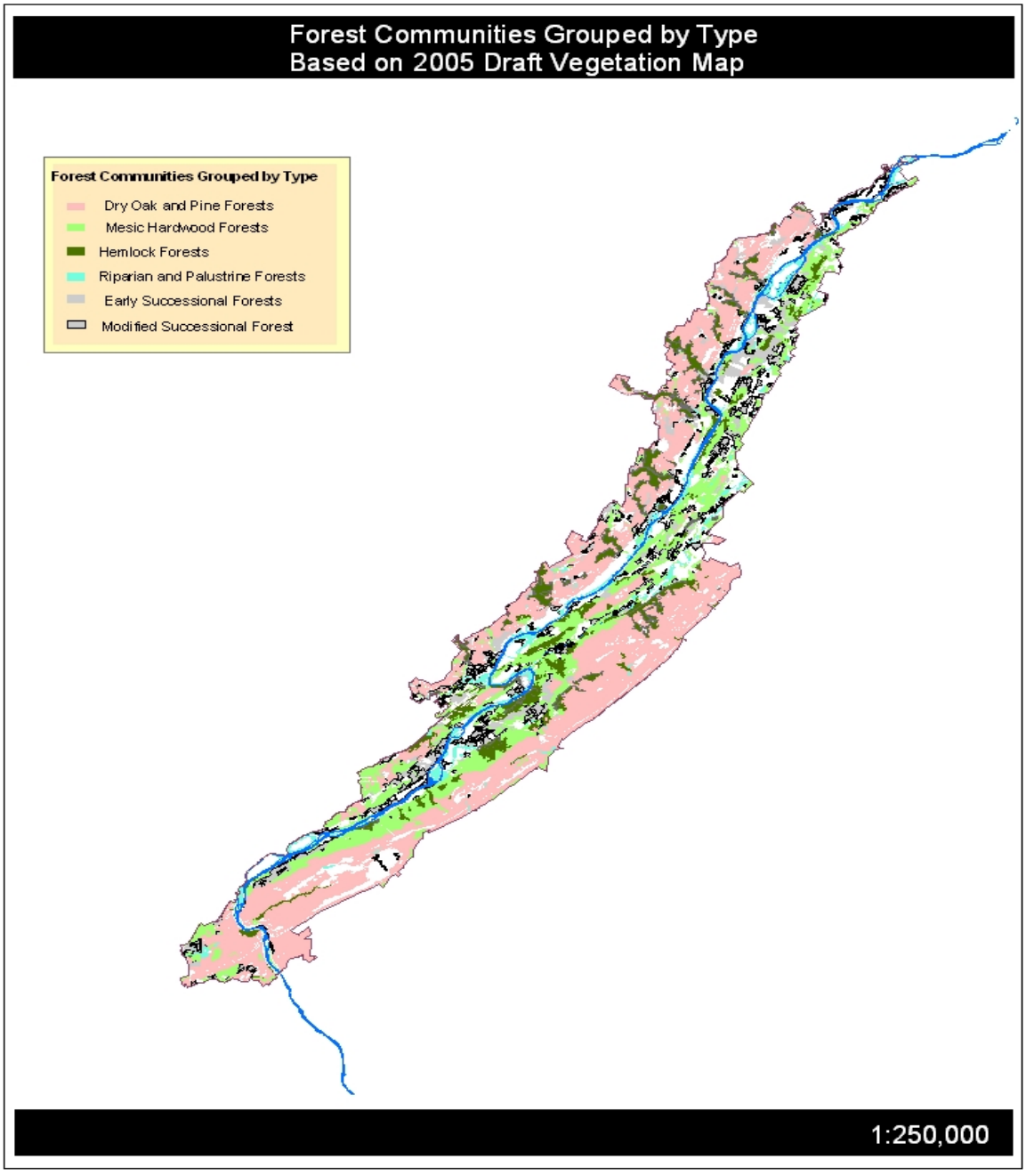


Figure 1: Distribution of Forest Community Types at DEWA

Fishes Inventory

Objectives: Fish inventories are being conducted at both Delaware Water Gap NRA and Upper Delaware Scenic and Recreational River and have three main objectives: (1) to ensure that at least 90% of the fish species in each park are officially identified and documented, either by verified historic data, or by field investigations and new voucher specimens; (2) to provide scientific information about the distribution and abundance of selected species in each park; (3) to provide information useful for developing an effective long-term environmental monitoring program for each park. Targets include 21 special concern and poorly documented species.
Cooperator: Philadelphia Academy of Natural Sciences; Dr. Richard Horwitz, principal investigator.
NPS Key Official: Richard Evans, ecologist.
Status: Funded in FY2003 via Cooperative Agreement H4320-03-0061. In FY05, an additional $25,000 was added to fund a third year of fieldwork (FY06), and an additional $5,000 was added specifically to study bridle shiners at UPDE in FY06. Draft final report/deliverables due December 2007.

2005 Highlights:
As of October, 2005, 52 fish species had been documented within DEWA, and 50 fish species within UPDE (nine of which had not previously been reported for UPDE). Bridle shiner (*Notropis bifrenatus*), an endangered species in Pennsylvania, was found in the Flat Brook in DEWA, and also at a site in UPDE. Western mosquitofish (*Gambusia affinis*), was collected in the Flat Brook drainage near the boundary of DEWA. The western mosquitofish is not native to this region, and has not previously been reported in DEWA.

Several priority species, including bridle shiner, Eastern mudminnow, and bluespotted sunfish, have been collected in backwaters and isolated pools adjacent to the main channel of the Delaware River. Persistence of these habitats depends on river hydrology, as affected by patterns of precipitation and river (reservoir) management. Bridle shiner found in Flat Brook. Photograph by J.F. Scarola. (right).

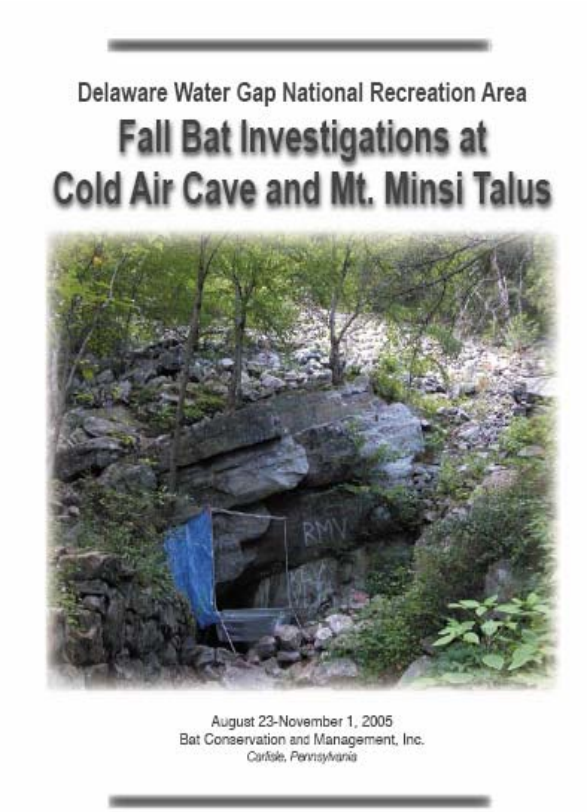
A poster titled “Inventories of Fish Species at the Delaware Water Gap National Recreation Area and Upper Delaware Scenic River” was presented at the 61st Northeast Fish and Wildlife Conference held in Virginia City, VA, April 17-20, 2995. A copy of this poster is available.

Bat Hibernaculum Survey at Cold Air Cave

Objectives: to assess the use and importance of Cold Air Cave and associated talus as a hibernaculum for overwintering bats.
Contractor: Bat Conservation & Management, Inc.
NPS Technical Representative: Jeffrey Shreiner
Status: funded by Purchase Order #4320050048 in FY2005. Project completed.

Inventory Highlights: Cold Air Cave is a small opening located in open talus lying below a steep escarpment on the eastern slopes of Mount Minsi, on the Kittatinny Ridge. About ten acres of open talus are surrounded by dry oak forest. The cave opening is approximately 2m by 2m but quickly diminishes in size. Cold air emanates from the opening, suggesting deep fissures below, where bats may overwinter. Preliminary investigations conducted in late July of 2004 identified five species utilizing the site: *Pipistrellus, Eptesicus, Myosotis lucifugus, M. leibii, and M. septentrionalis* (Chenger 2004).

To assess the use and importance of the site as a bat hibernaculum, Bat Conservation & Management conducted a late-season survey spanning the entire fall swarming period. Live-trapping techniques were used to survey the cave entrance and acoustic devices to monitor the associated talus. Over 150 individuals representing three species were captured over a ten-week period, from late August to early November. Three additional species were detected by acoustic monitoring only. A significant portion of captures and recordings were made during late August and early September sampling. Many of these detections comprised male little brown and northern long-eared bats, suggesting that this site may be a favorable summer day roost for these "bachelors". Previous work identified male Eastern small-footed bat (Pennsylvania threatened) at this location in July, but this species was absent during this project, suggesting summer use only for this species. No Indiana bats were detected, so it is unlikely that Cold Air Cave serves as an important overwintering site for this endangered chiropteran.



Related Scientific Research
Consistent with NPS policy, DEWA provides research opportunities to outside scientists who are working independently and without NPS funding. Study topics are chosen by the principal investigators based on their own research interests. Nearly 50 permits were active in 2005 and many involve biological inventories or long-term monitoring programs. Two examples are highlighted below.

Bryophyte and Lichen Surveys (Research Study DEWA-00089). This is an inventory of the park's lichens and non-flowering plants, including mosses, liverworts and hornworts. The principal investigator is botanist William Olson, who is collaborating with subject matter experts from the New York Botanical Garden and the Academy of Natural Sciences of Philadelphia. Collections made during the First Howard Crum Bryophyte Workshop, hosted by the Pocono Environmental Education Center in 2004, yielded checklists of 209 lichens and 184 bryophytes.

Two lichens new to North America, and one species new to science, were subsequently reported in *Opuscula Philolichenum*, a privately published journal. The new lichen, named *Opegrapha bicolor*, was found on the Hogback Ridge growing on the bark of a white oak. Overall, the investigators were "quite surprised by the apparent high lichen density, as well as the number of novelties and rarities, in an area so close to the East Coast megalopolis." They estimate that about 300 species of lichens have been reliably reported for the park in the last 30 years, and that additional collecting would add significantly to this number.

Treehopper Survey (Research Study DEWA-00088). This is an inventory of the park's treehoppers, a group of plant-feeding insects known for their bizarre forms and unusual behaviors. Dr. Matthew Wallace is conducting a two year study that has yielded 199 specimens representing 28 species. Vouchers are housed at East Stroudsburg University and have been entered into the NPS Automated Catalog System. Future work may include additional insect taxa. *Glossonotus univittatus*, a treehopper associated with oak trees (right)

Other Research Projects Related to Inventory and Monitoring:

- DEWA and UPDE Freshwater mussel survey (U.S.G.S. Biological Resources Div.)
- NY Metropolitan Flora Project (Brooklyn Botanic Garden)
- Aquatic Plant Inventory of Northeastern PA (University of Pennsylvania)
- PA Aquatic Community Classification (The Nature Conservancy, PA Science Office)
- Trace Fossil Inventory (Kean College of New Jersey)
- Eastern woodrat monitoring (PA Game Commission)
- Hemlock health and HWA monitoring (NJ Dept. of Agriculture)
- Black Bear Population Monitoring (NJ Div. of Fish & Wildlife)
- Shad Migration Monitoring (NJ Div. of Fish & Wildlife)

- Acadian Flycatcher Population Monitoring (East Stroudsburg University)
- Water Quality Monitoring (PA DEP; Pike County Conservation District)
- Rare plant community monitoring (The Nature Conservancy, NJ Field Office)
- Bald Eagle nest monitoring (NJ Div. of Fish & Wildlife)
- Inventory of Trout Production Streams (NJ Div. of Fish & Wildlife)
- Inventory of Native and Invasive Crayfish of Pennsylvania (Penn. State Univ.)
- Raptor Banding at Totts Gap (citizen science project)

For more information, consult the NPS Research Permit and Reporting System website and search the database (from NPS computers only):
https://science1.nature.nps.gov/research/ac/ResearchIndex

NatureBib

NatureBib is an NPS bibliographic database which catalogs reports, journal articles, and other park-specific documents pertinent to natural resources.

We updated NatureBib to add new documents received this year, bringing the total number of DEWA records to 2803 (Table 4).

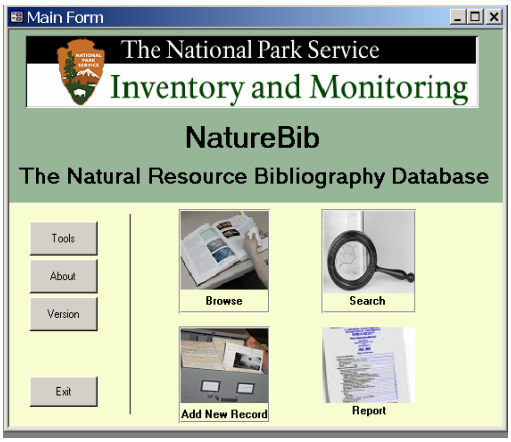
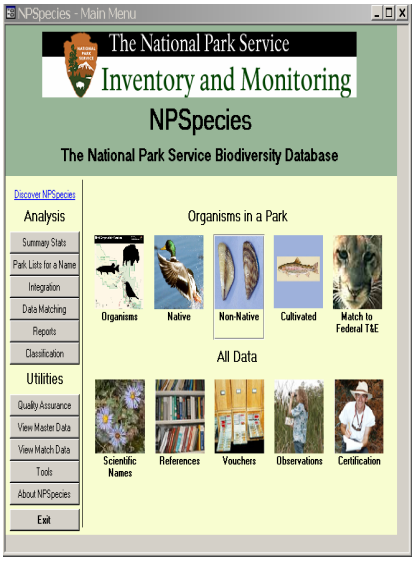


Table 4: DEWA Natural Resource Documents add to NatureBib in 2005

BibKey	Citation
590960	Castellano, C. M. and J. L. Behler. 2005. Post-Emergent Behavior of Hatchling Wood Turtles, Glyptemys Insculpta, in Agricultural Fields: Modification of Farming Practices to Promote Species Survival.
596700	Castellano, C. M. and J. L. Behler. 2005. Site Selection and Hatching Success of Wood Turtle Nests at Delaware Water Gap National Recreation Area: Recommendations for Managing Agricultural Fields as Wood Turtle Nesting Areas.
60676	Bat Conservation and Management, Inc. 2005. Fall Bat Investigations at Cold Air Cave and Mt. Minsi Talus.
596917	Gray, E. v. S., R. M. Ross and R. M. Bennett. 2005. Bioassessment of Fish Communities of the Upper Delaware River. Northeastern Naturalist. **12**:203-216.
590209	Harris, R. C. and J. C. Lendemer. 2005. Contributions to the Lichen Flora of Pennsylvania: A Checklist of Lichens Collected During the First Howard Crum Bryological Workshop, Delaware Water Gap National Recreation Area. *Opuscula Philolichenum*. **2**:1-10.
581316	Shaw Environmental, Inc. 2005. Columbia Gas Transmission Corporation, Line 1278 Replacement Project: Statement of Findings for Wetlands.
591786	Snyder, C. D., J. T. Julian, J. A. Young and T. L. King. 2005. Assessment of Ambystomid salamander populations and their breeding habitats in Delaware Water Gap National Recreation Area.

NPSpecies

We continued work on NPSpecies, the NPS database which documents the organisms in a park. Species are grouped by taxa; priorities include mammals, birds, amphibians, reptiles, and vascular plants.



This year, our vascular plant dataset (flowering plants and ferns) was reviewed and "certified" by the national program office. Certification is protocol used by NPSpecies managers to assure data quality. Only certified datasets are posted to the NPSpecies website.

Four additional datasets – Amphibians, Reptiles, Mammals, and Birds – will be submitted for certification in 2006.

Access to the NPSpecies database is available to all park staff. For more information, contact the Research & Resource Planning office.

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Bat Conservation and Management, Inc. 2005. Fall Bat Investigations at Cold Air Cave and Mt. Minsi Talus. Unpublished Report.

Bat Conservation and Management, Inc. 2004. Columbia Gas Transmission Corporation, Line 1278 Replacement Project: Woodland Bat Survey.

Fancy, Steven G. Monitoring Natural Resources in our National Parks. Downloaded from the National Park Service Inventory & Monitoring Website.

Eastern Rivers and Mountains Network: Annual Administrative Report (FY2005) and Work plan (FY2006) For Inventories and Vital Signs Monitoring. 2005. Prepared by Matt Marshall. Unpublished.

Eastern Rivers and Mountains Network: Long-Term Ecological Monitoring Program Phase 2 Report. 2005. Compiled and Edited by Matt Marshall and Nathan Piekielek. Unpublished.

Rust, Marie. 1999. Implementing the Natural Resource Challenge in the Northeast Region. Memorandum of October 13, 1999.

INTERNET RESOURCES

For more on the NPS I&M Program: www.nature.nps.gov/im/index.htm
For more on the ERMN: www1.nature.nps.gov/im/units/ermn/index.htm
For more on the NPSpecies database: www.nature.nps.gov/im/apps/npspp/index.htm
For more on the Nature Bibliography: www.nature.nps.gov/im/apps/nrbib/index.htm

For more on the NPS Director's Challenge: www1.nrintra.nps.gov/challengedoc
The NPS Research Permitting and Reporting System:
https://science1.nature.nps.gov/research/

WATER QUALITY MONITORING

Prepared by

Allan Ambler
Biologist

and

Matthew Bennett
Conservation Associate
Student Conservation Association

ABSTRACT

Delaware Water Gap National Recreation Area (DEWA) conducts water quality monitoring of the main stem Delaware River and its tributaries within the boundaries of the park. This monitoring is conducted in partnership with the Delaware River Basin Commission (DRBC) and the Upper Delaware Scenic and Recreational River (UPDE) in support of the Special Protection Waters Regulations (DRBC, 1993). In 2005, DEWA monitored seven sites on the main stem biweekly from May through September in support of the regulations. We also cooperated with DRBC to conduct 50 monitoring visits at five sampling sites within the tri-state region above the upstream boundary of the park. This effort developed data to support a predictive model to determine if land use changes in the tri-state region could measurably change water quality at our northern boundary. In keeping with our decision in 2001 to analyze main stem data annually, the 2005 data is presented along with the previous nine years of data for comparative purposes. As in previous years, the comparison of both site specific and reachwide seasonal means for five parameters are presented in order to identify specific sites that may be undergoing change that would be masked by the analysis of reachwide means alone.

INTRODUCTION

The Special Protection Water Regulations, as adopted in 1993 by DRBC, are supported by the Scenic Rivers Monitoring Program (SRMP). The SRMP monitors the water quality of the Delaware River and its tributaries within DEWA and UPDE. The monitoring program is run cooperatively by the National Park Service (NPS) and DRBC. The regulations state that no measurable change, except toward natural conditions, is permissible. The definition of existing water quality, or baseline condition, of the main stem river was established for 16 parameters upon adoption of the Special Protection Waters Regulations in 1993. The goal of the SRMP is to detect change in water quality as defined by the regulations. The program also collects data that can be used to define additional parameters. Both DEWA and UPDE operate similar monitoring programs with technical guidance and assistance from DRBC. DEWA monitors seven sites along the main stem of the Delaware River.

The 1993 Special Protection Waters Regulations provided for the development of similar regulations for tributaries at the point where they enter the park. Sufficient data to define existing water quality of the tributaries was not available at the time the regulations were adopted. Developing this data set became the focal point of the monitoring program in 2002 with the implementation of a three-year cooperative study between the NPS and the US Geological Survey (USGS). The study focused on developing baseline information for 14 tributaries entering into DEWA. Funding for the study was acquired competitively through the servicewide Comprehensive Call, specifically the NPS/USGS Water Quality Monitoring and Assessment program administered by the Water Resource Division of the Washington Support Office. The three-year data collection effort ended in 2004 and data analysis was completed in 2005. A final report from USGS is pending.

In an effort to prevent, rather than simply document measurable change, planning tools are required to predict whether land use changes could cause measurable change to water quality at the boundary control points. One such tool is a model that is being developed for the 8.5 mile section of the main stem Delaware River that lies between the downstream border of UPDE and the upstream border of DEWA. NPS staff cooperated with DRBC to collect water quality data necessary for the calibration of this model.

Sampling Methods and Locations for River Monitoring

The SRMP operates under protocols developed cooperatively by the NPS and DRBC and described in "Redesign of the DRBC/NPS Scenic Rivers Monitoring Program" (Report No. 18; March 1995). A Laboratory and Field Manual provides procedures for operating, maintaining, and calibrating the equipment, as well as field and laboratory procedures for sample collection, storage, and analysis. The manual is reviewed annually and updated as needed.

A Quality Assurance/Quality Control Plan describes the procedures that the program follows to insure quality data. The Quality Assurance/Quality Control Plan is updated annually and reviewed by the Environmental Protection Agency.

The Redesign Document (1995) describes the sampling design and provides justification for the frequency and location of monitoring. The document is revised as data analysis indicates the need or if program objectives are changed. The analysis conducted in 2001 indicated that biweekly sampling conducted from May through September provided the best attainable dataset to describe Delaware River water quality on an annual basis. The sampling in 2005 continued at the same sites as in previous years (Table 1).

Table 1. River Monitoring Locations and Site Visits

	Sampling Sites	Total Number of Site Visits
MAIN STEM	Port Jervis/Matamoras Bridge	13
	DEWA at Northern Boundary	13
	Milford Access	13
	Dingmans Access	12
	Bushkill Access	12
	Smithfield Access	12
	Kittatinny Point	12

NPS/USGS Tributary Study

This study was funded by the NPS/USGS Water Quality Monitoring and Assessment program administered by the NPS Water Resources Division through the servicewide Comprehensive Call. The primary goals of the study are to: 1) develop baseline conditions from which tributary specific regulatory criteria can be developed; and 2) investigate impacts to tributaries from low density residential development. Sampling was completed in 2004. The USGS conducted data analysis and report writing in 2005. Data analysis is complete and a report is pending.

Tri-State Monitoring
Five sites within the study area were each sampled 10 times. Routine field parameters were sampled on site and water samples were collected for shipment to a laboratory contracted by DRBC for analysis. The five sample sites included four on the main stem Delaware River and one on the Neversink River (Table 2).

Table 2. Sampling Sites

	Sampling Sites	Number of Site Visits
MAIN STEM	Millrift	10
	Port Jervis/Matamoras Bridge	10
	DEWA at Northern Boundary	10
	Milford Access (Montague)	10
TRIBUTARY	Neversink River at 209 bridge	10

Data Management
River monitoring data is checked for accuracy and entered into an Excel spreadsheet by park staff for transfer to DRBC. The data is reviewed by DRBC, verified, and entered into the Environmental Protection Agency "STORET" program, a nationwide database of water quality data.

Tri-state monitoring field data was recorded on field data sheets and transferred to DRBC. A copy was included with the samples sent for laboratory analysis and a second copy was kept for our records. DRBC personnel entered field data and the result of the laboratory analysis in their database.

Data Analysis
In 2001, staff at R&RP decided that annual analysis of water quality data was necessary to track water quality trends effectively and to evaluate the efficacy of the program. In keeping with that decision, this report presents the comparison of 2005 river water quality data with the past nine years of monitoring data. In keeping with the 1995 Scenic Rivers Monitoring Program Redesign Document, data was analyzed as a reachwide mean with data from all sites forming a single seasonal dataset. An additional site specific analysis was conducted to determine if site specific analysis would provide an early indication of localized water quality degradation. The data is graphically presented as a comparison of reachwide seasonal means and site specific seasonal means for the past 10 years. The analysis utilized the procedures described in Evans, 2002. Only data collected by R&RP along the main stem of the Delaware River was included in the analysis. As in previous years, this report precedes an analysis of the data by DRBC and therefore must be considered provisional.

Data Analysis Procedures
DRBC provided “STORET” database files containing middle Delaware River seasonal (May-September) data for 1992-1998. The data was transferred to Excel format and the data from 1994 through 1998 used for this analysis. Data for 1999-2003 was taken from

existing Excel documents at DEWA. For fecal coliforms with a TNTC (too numerous to count) result, a value of 200 colonies/per 100ml was used.

Yearly means with 95% confidence limits were calculated. The methods were the same as used in "Evaluation of SRMP Water Quality Data in relation to SPW Regulatory Standard" (Evans, 2002). All the data were converted to units used in the regulatory standards. The logarithm of each data value was calculated (except pH and percent oxygen saturation). A yearly mean of the log-transformed data was calculated and the anti-log of this mean was taken, producing a "geometric mean." The normal distribution was used to calculate confidence limits using the log-transformed data. The anti-logs of these logarithmic confidence limits were then calculated to obtain 95% confidence limits in the original units.

RESULTS/DISCUSSION

The results for five parameters at seven sites are presented in graphical format in Appendix A. The graphs use box and whisker plots to depict site specific means and reachwide means. The geometric mean for each season's data is represented by a box. Whiskers extending above and below each box represent the corresponding 95% confidence limits. The graphs are presented in order from the upstream site to the downstream site.

Apparent differences between site specific and reachwide seasonal means do not necessarily indicate statistically significant differences. The DRBC is presently conducting an analysis of site specific vs. reachwide data for the Lower Delaware and intends to conduct a similar analysis for the Middle and Upper Delaware reaches in the near future. Preliminary results from the Lower Delaware indicate that site specific analysis will provide earlier warning of localized degradation than the existing reachwide means. Existing datasets for the Middle and Upper Delaware reaches may not be adequate for the development of the definitions of existing conditions at all sites or for all parameters. The results of this analysis will identify data gaps to be filled by future data collection efforts.

One concern associated with site specific data vs. reachwide data is the amount of data that can be reasonably collected. The reachwide dataset consists of all data collected at all sites monitored. Seven sites are presently monitored on a biweekly basis resulting in a seasonal dataset consisting of approximately 70 records for each parameter. The dataset for each site consists of approximately 10 records for each parameter. The bar and whisker plots in the accompanying graphs indicate that the confidence limits surrounding site specific means are wider than those for the reachwide means. This reduces the confidence that the site specific means accurately represent existing water quality. The results of the DRBC analysis will help determine if sampling frequency must be increased, either by more frequent site visits or by using continuous, automated samplers.

Precipitation was lower than normal during the 2005 summer field season despite extreme flooding in the Delaware River Basin in early April. The lack of precipitation

through the summer months resulted in relatively stable river levels. The near constant discharge was maintained through reservoir releases in the Upper Basin. The water quality data for the season indicates what should be expected during a period of low runoff and stable river levels. Turbidity and fecal coliform bacteria results were reduced due to the lack of runoff. Conductivity, which is a measure of ionic concentration that can come from both natural and man made sources, increased slightly. This could indicate that the sources of ions are relatively stable and are diluted when water levels increase. It may also indicate that reservoir releases, which comprise a higher percentage of the discharge during dry periods, are of higher specific conductance than the receiving waters. Both dissolved oxygen percent saturation and pH remained at or near normal levels when compared to previous years.

Probably the most notable indicator of the stable hydrologic conditions experienced during the field season is the lack of variability in the data when compared to past years when rain events resulted in more fluctuation in the parameters.

Data tables showing the number of samples, geometric mean, and numeric values for the confidence intervals are available upon request as an additional appendix to this report.

PROGRAM DISCUSSION AND PLANS FOR 2006

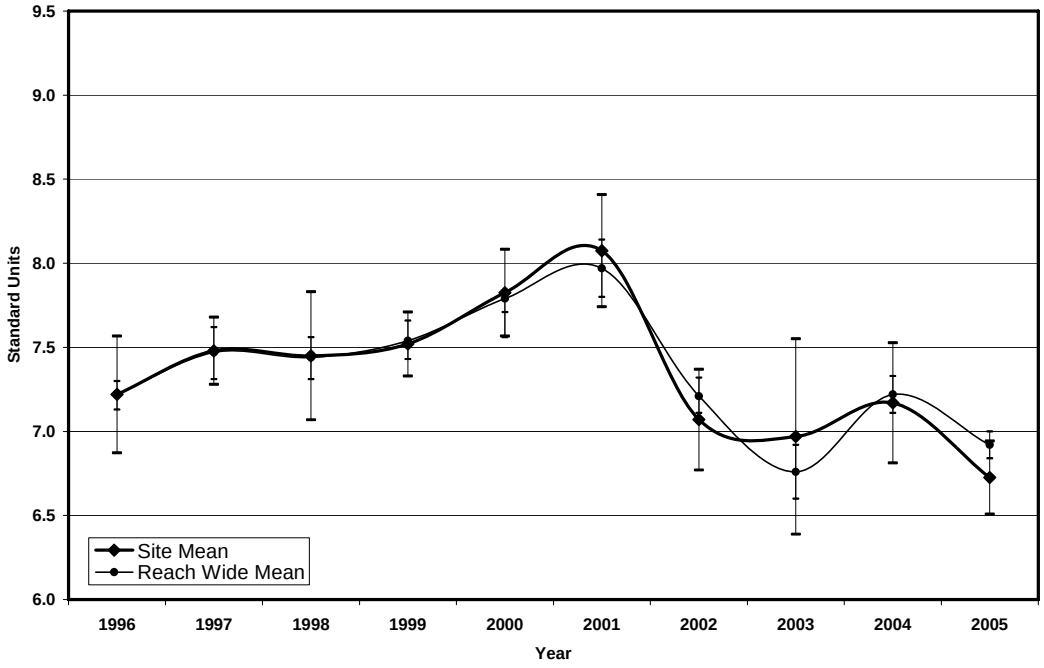
Program Review

The main stem monitoring program continues to follow the program design implemented following the 1994 adoption of the Special Protection Water Regulations. Both DRBC and the NPS have acknowledged that the program needs to be redesigned to better assess water quality conditions within present day staffing and budget conditions. The DRBC has been engaged in a monitoring program on the Lower Delaware and is presently analyzing that data. Methods from the Lower Delaware program will be evaluated to determine if they are appropriate for use in the Middle and Upper Delaware. Additionally, the pending NPS/USGS tributary monitoring report will help identify the parameters that are most sensitive to a change in water quality conditions in DEWA. The information acquired by DRBC and the NPS in recent years will form the basis for a redesign of the Scenic Rivers Monitoring Program partnership.

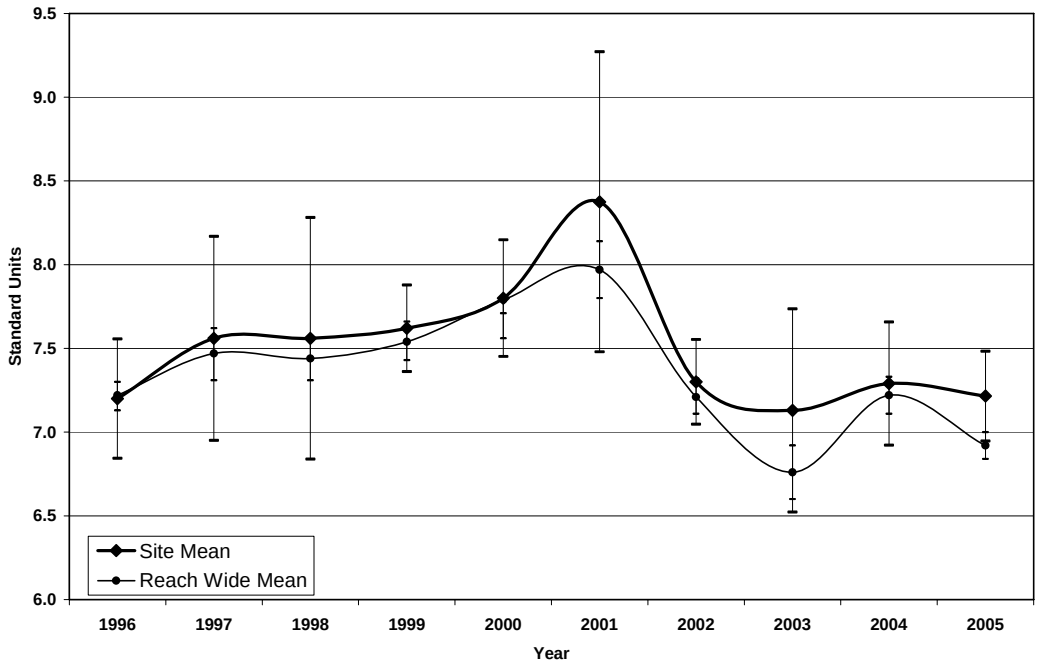
Monitoring Efforts for 2006

Bi-weekly monitoring of the seven main stem river sites will continue as in previous years. Additional monitoring may be conducted on select tributaries, especially those that were not monitored in recent years. Additional parameters may be added at both the main stem and tributary sites if funding is available for laboratory analysis. A monitoring meeting scheduled with DRBC in early February will help determine if additional monitoring is possible. A Student Conservation Association, Conservation Associate will again be obtained to conduct the sampling.

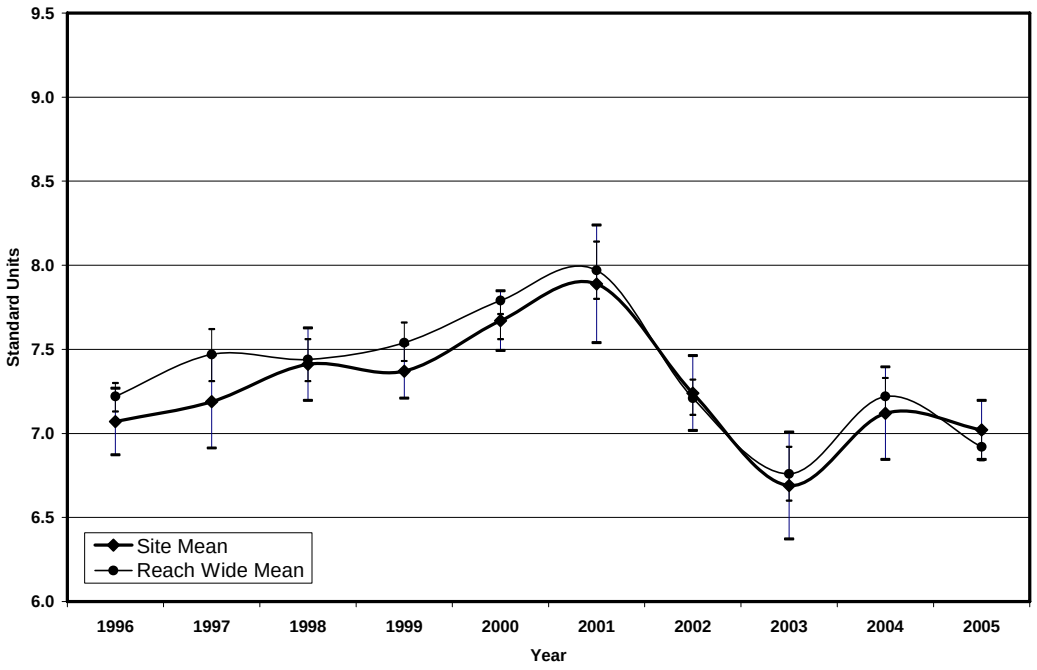
Mean Seasonal pH For Matamoras/Port Jervis Bridge



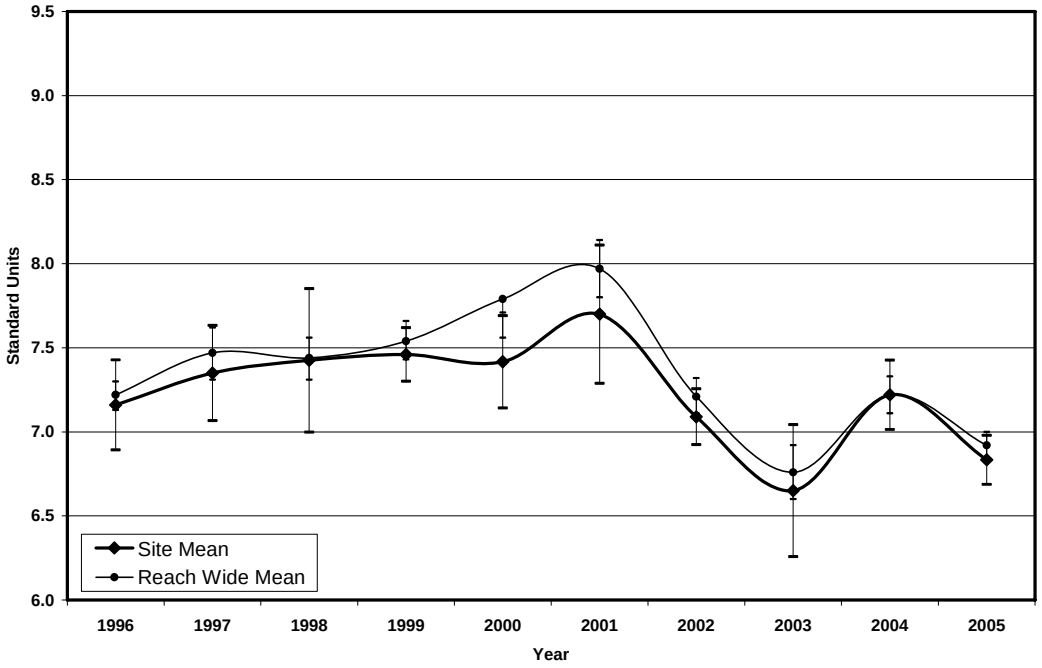
Mean Seasonal pH for Northern DEWA Boundary



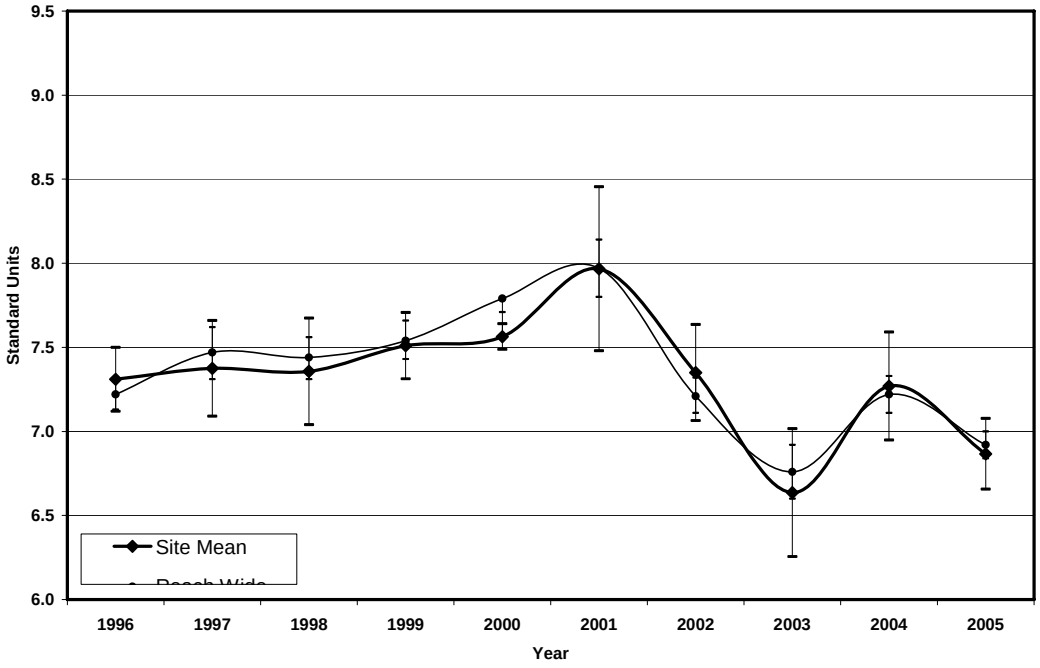
Mean Seasonal pH for Milford Beach



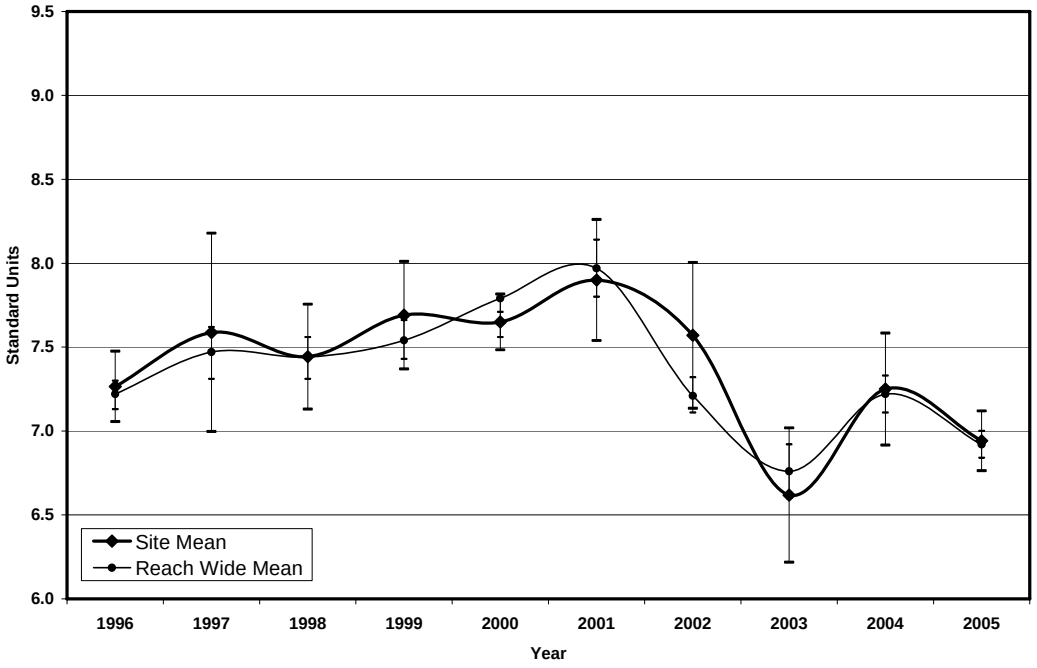
Mean Seasonal pH for Dingman's Ferry Access



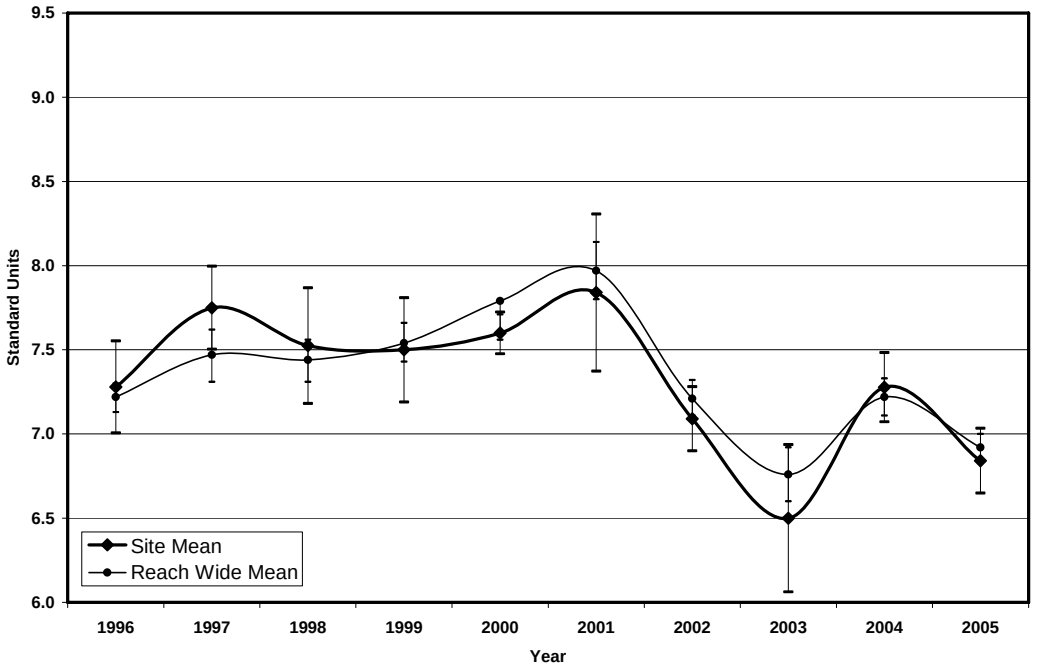
Mean Seasonal pH for Bushkill Access



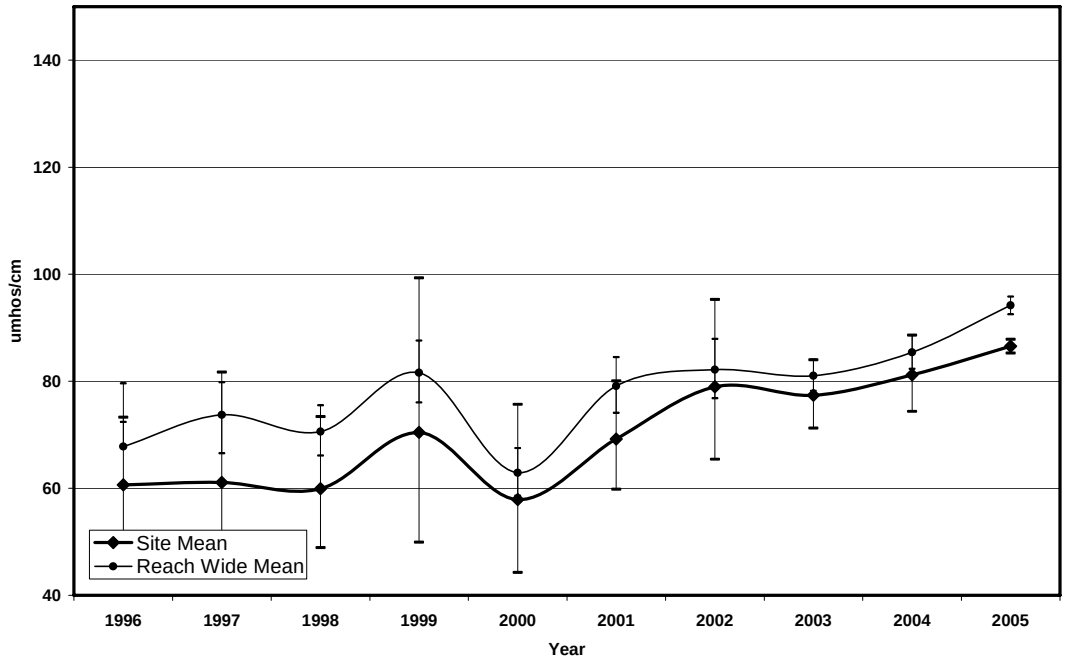
Mean Seasonal pH for Smithfield Beach



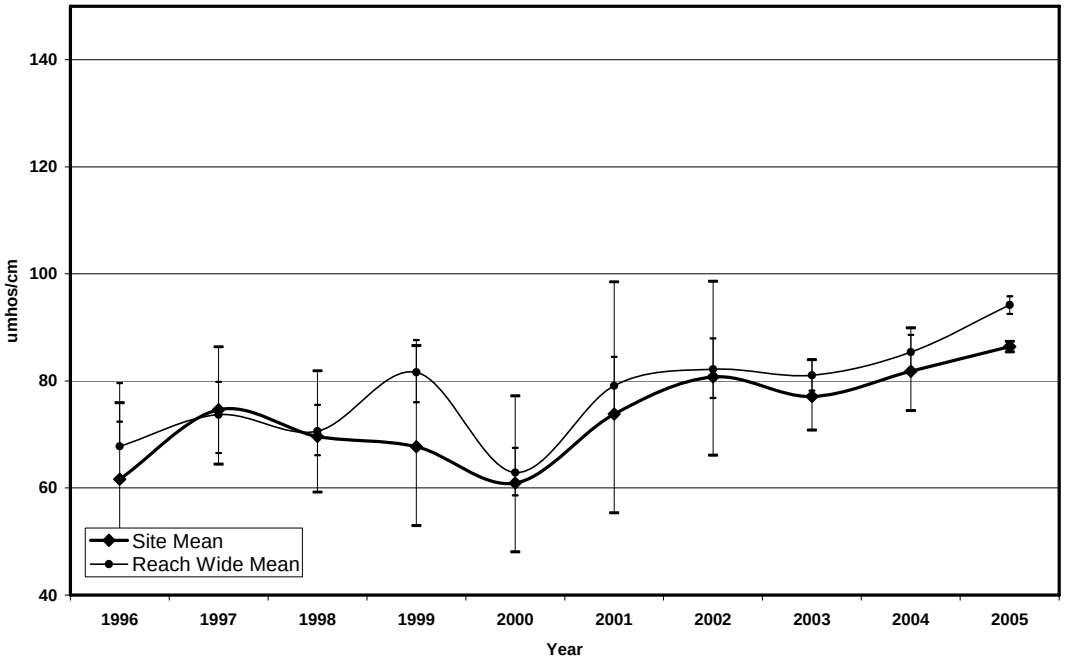
Mean Seasonal pH at Kittatinny Point



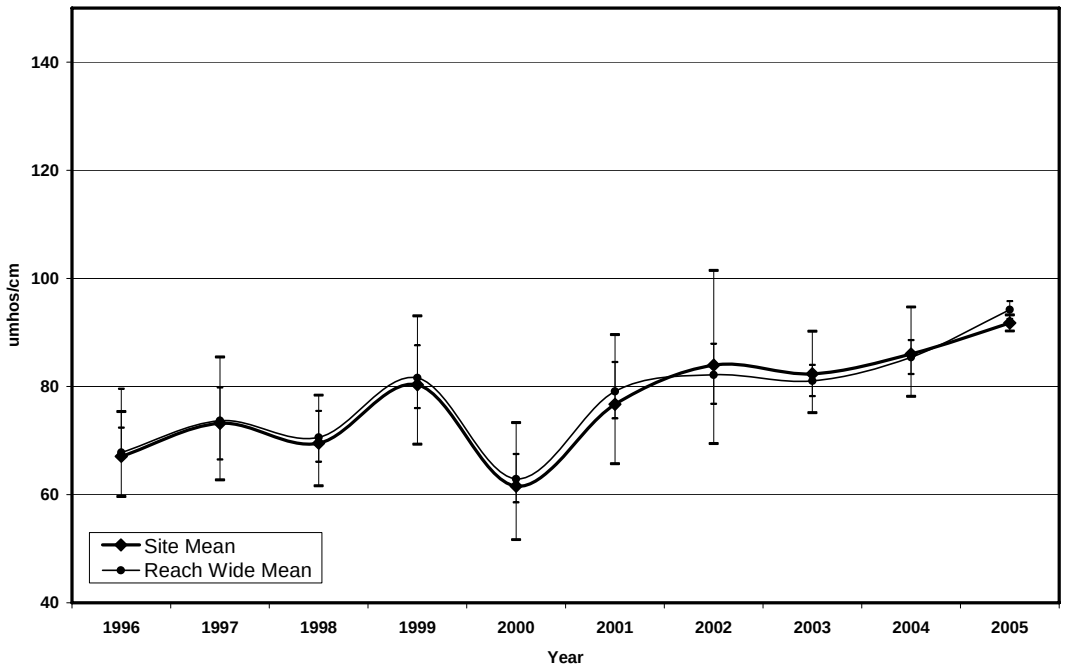
Mean Seasonal Conductivity for Matamoras-Port Jervis Bridge



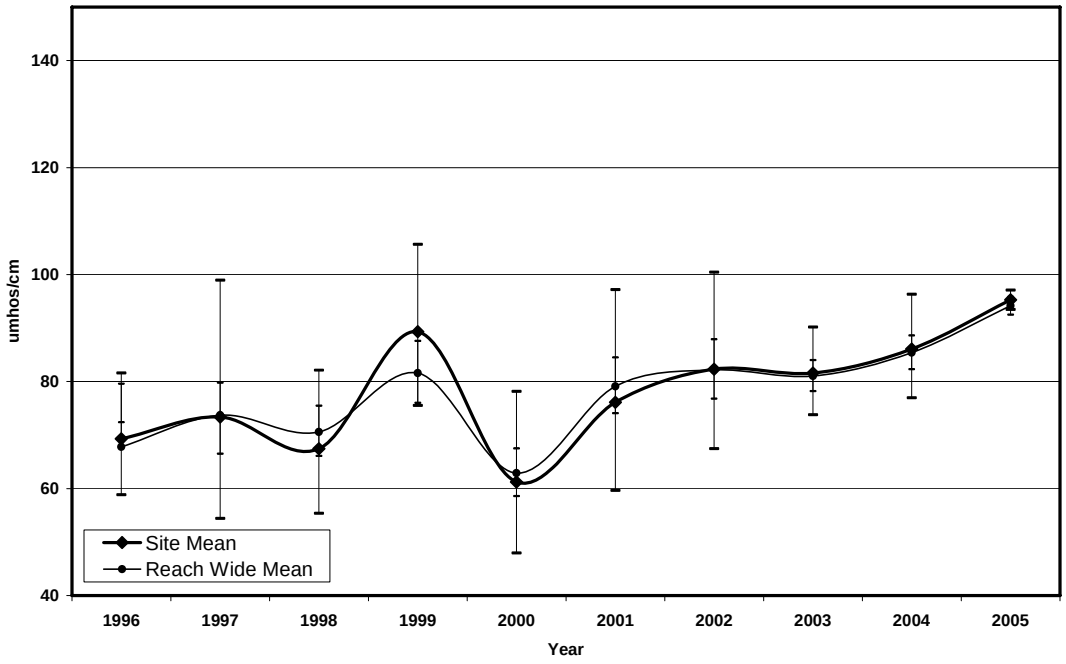
Mean Seasonal Conductivity for Northern DEWA Boundary



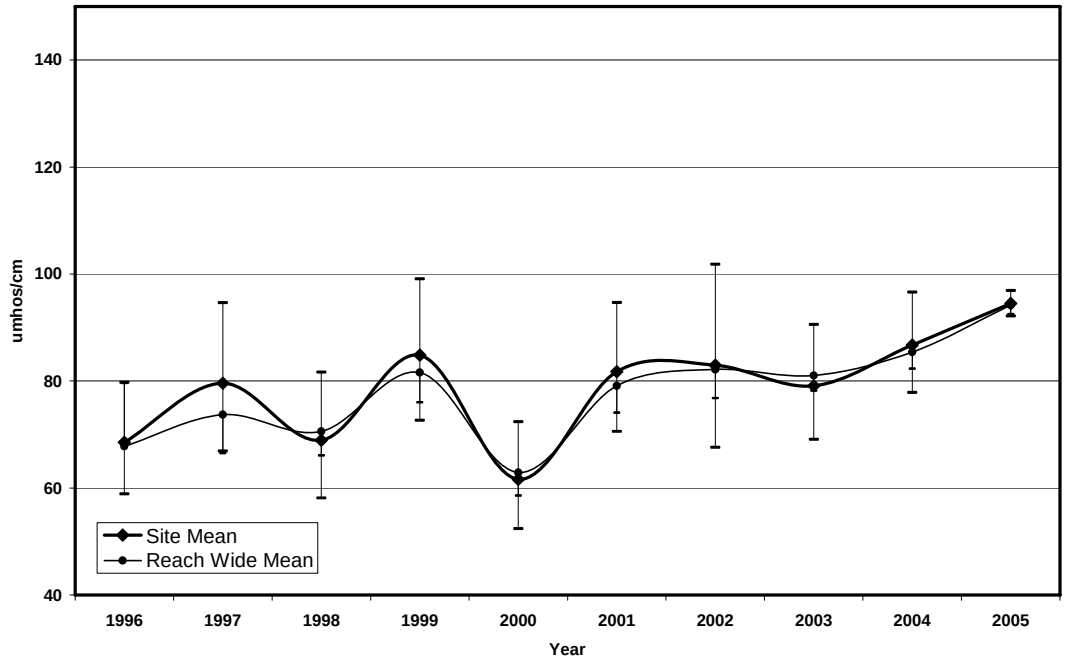
Mean Seasonal Conductivity for Milford Beach



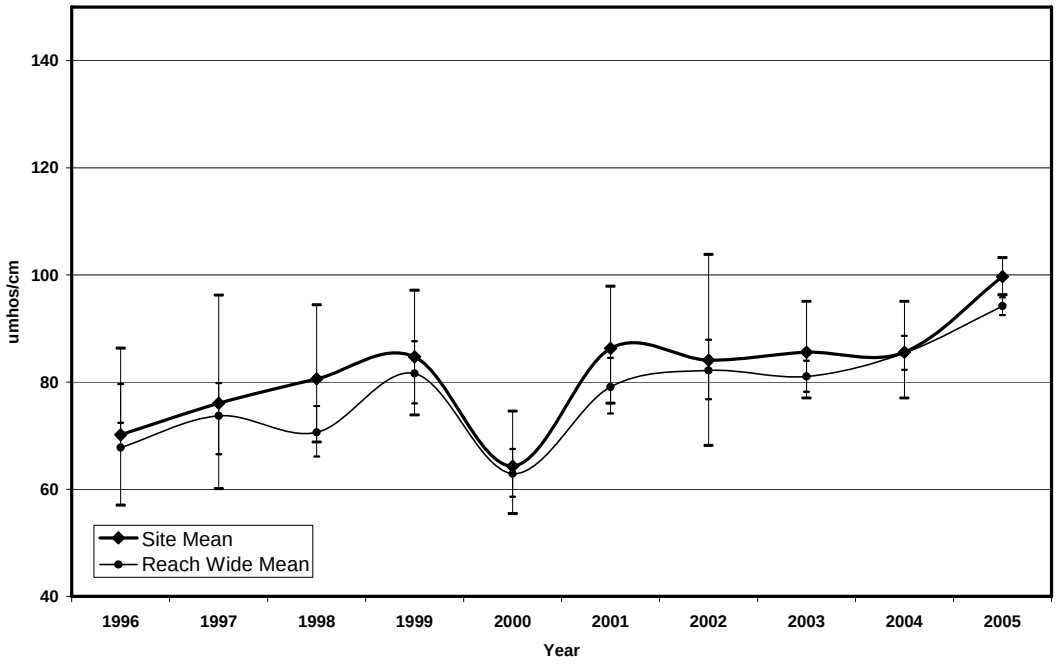
Mean Seasonal Conductivity for Dingman's Ferry Access



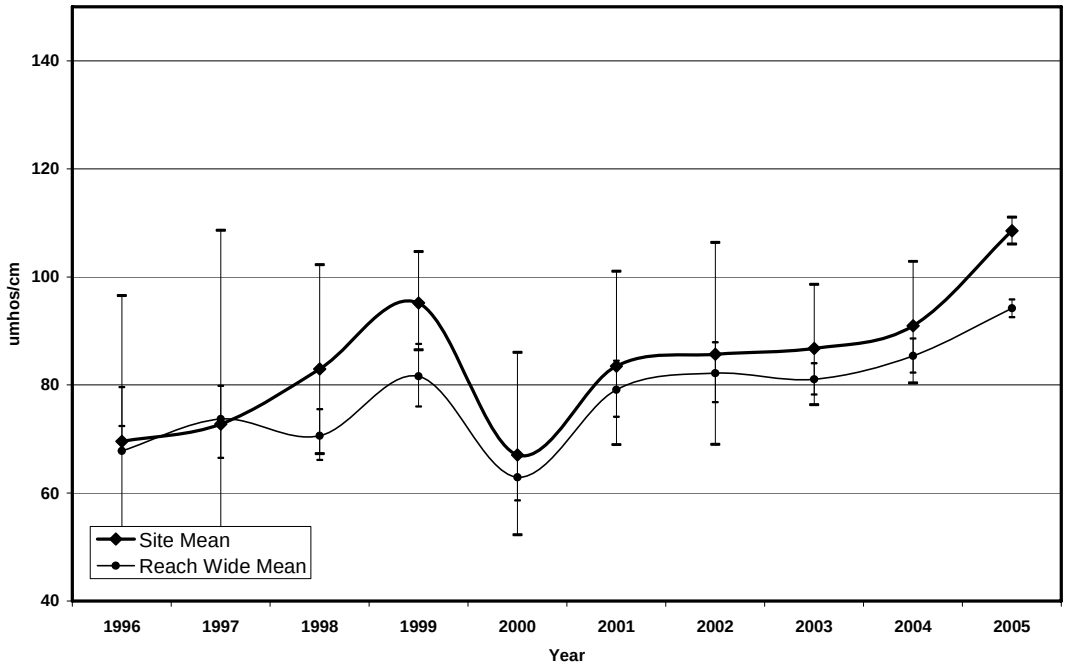
Mean Seasonal Conductivity for Bushkill Access



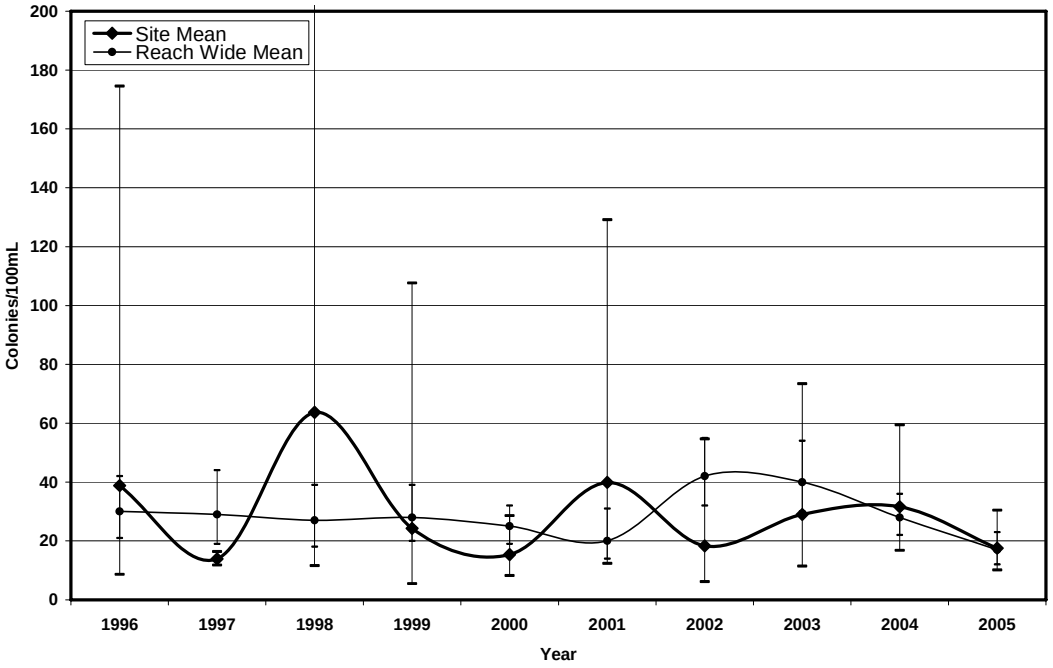
Mean Seasonal Conductivity for Smithfield Beach



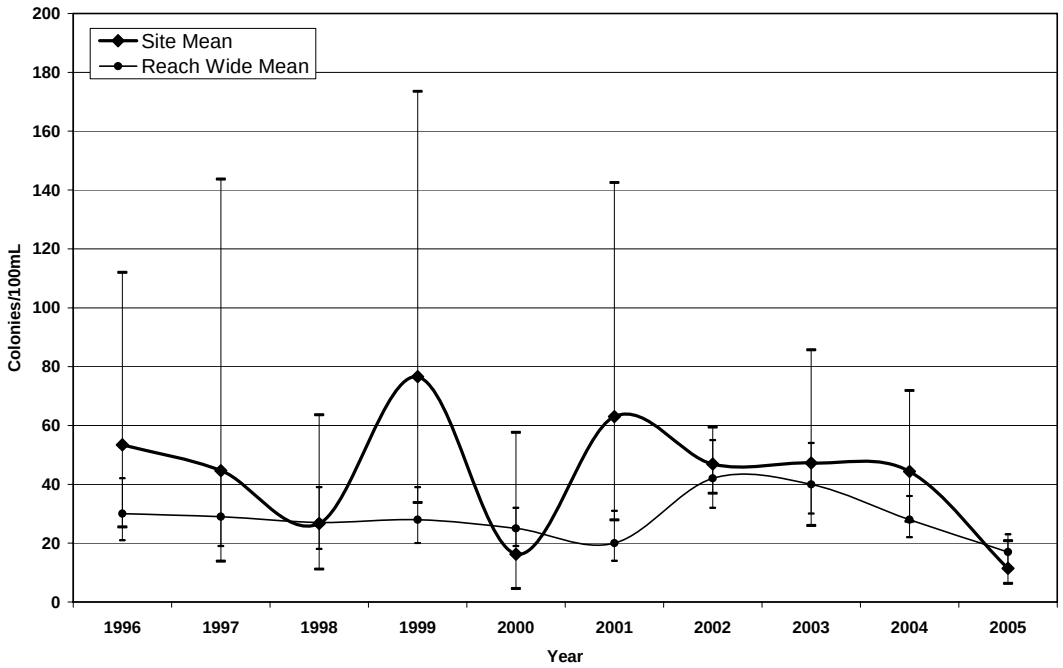
Mean Seasonal Conductivity for Kittatinny Point



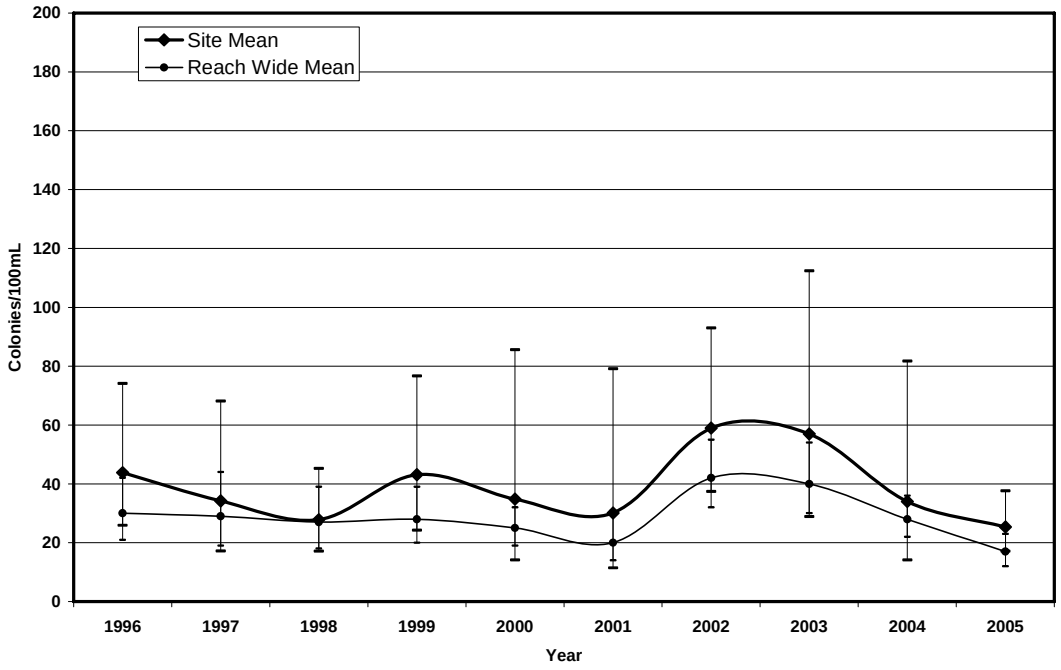
Mean Seasonal Fecal Coliform for Matamoras-Port Jervis Bridge



Mean Seasonal Fecal Coliform for Northern DEWA Boundary



Mean Seasonal Fecal Coliform for Milford Beach



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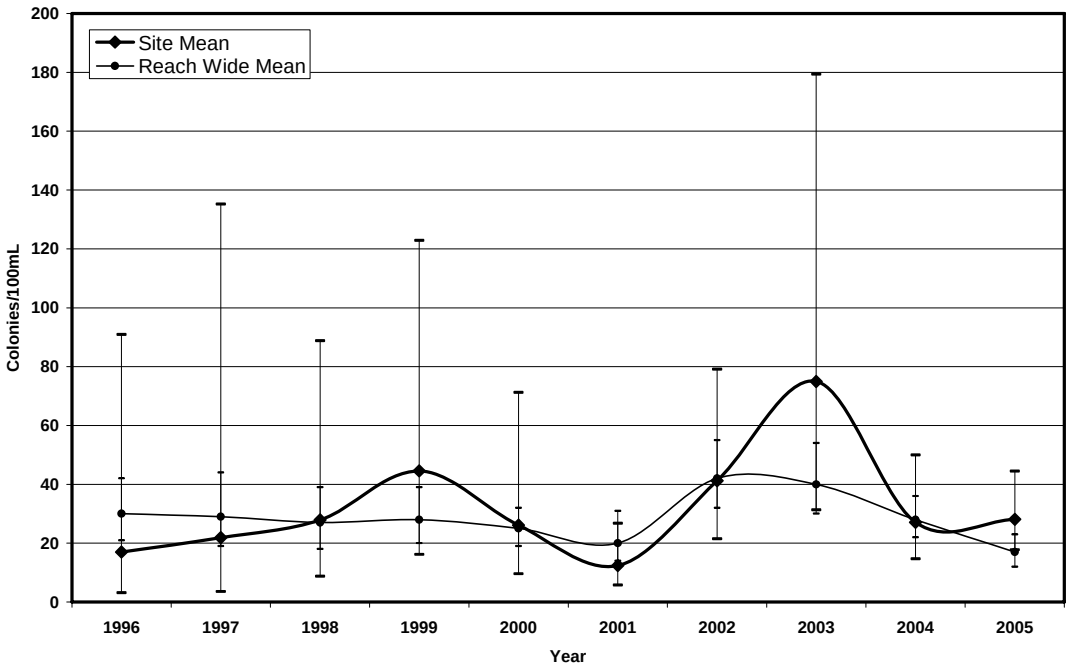

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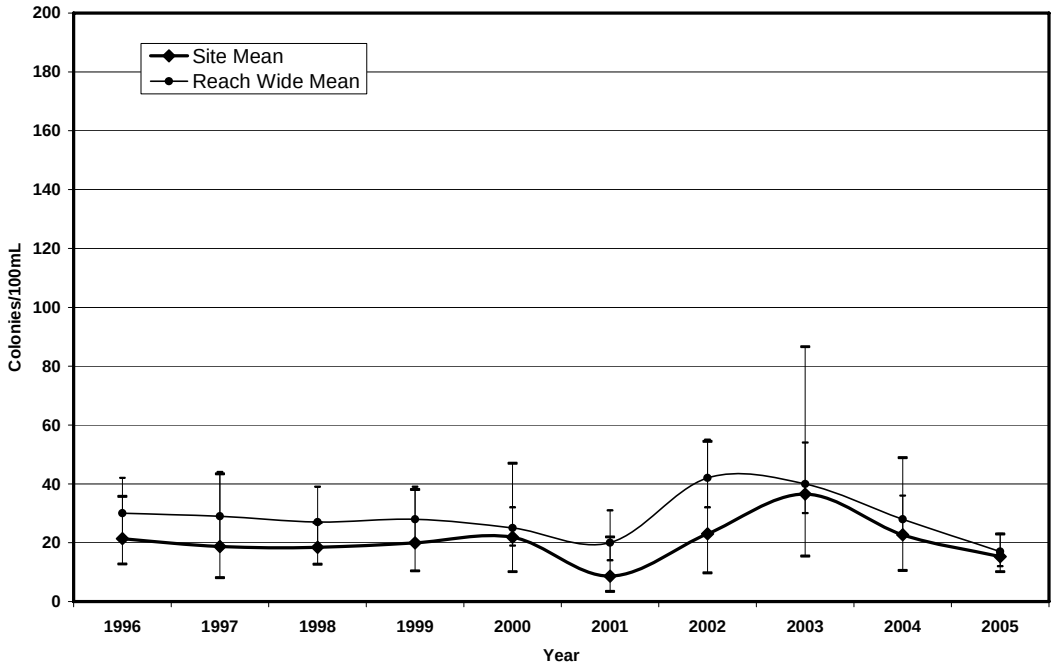

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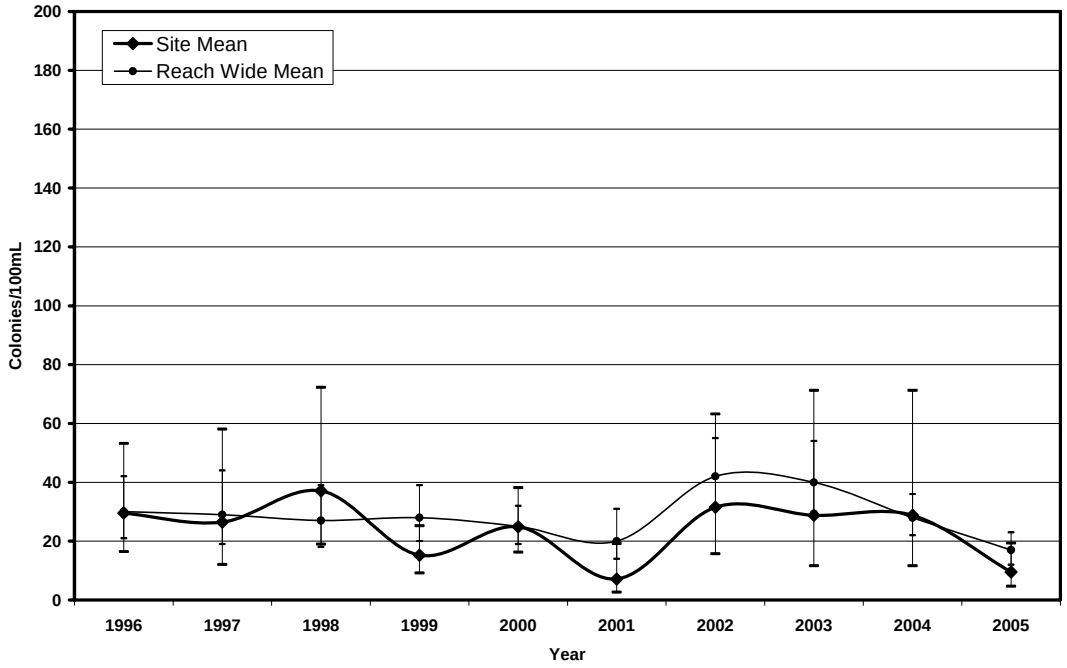

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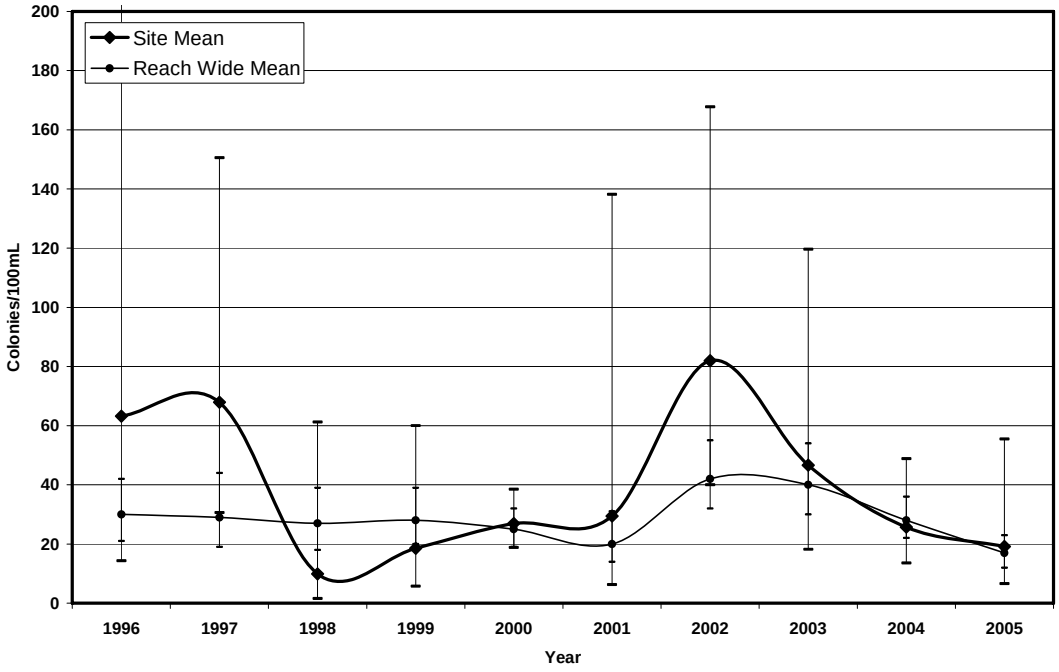
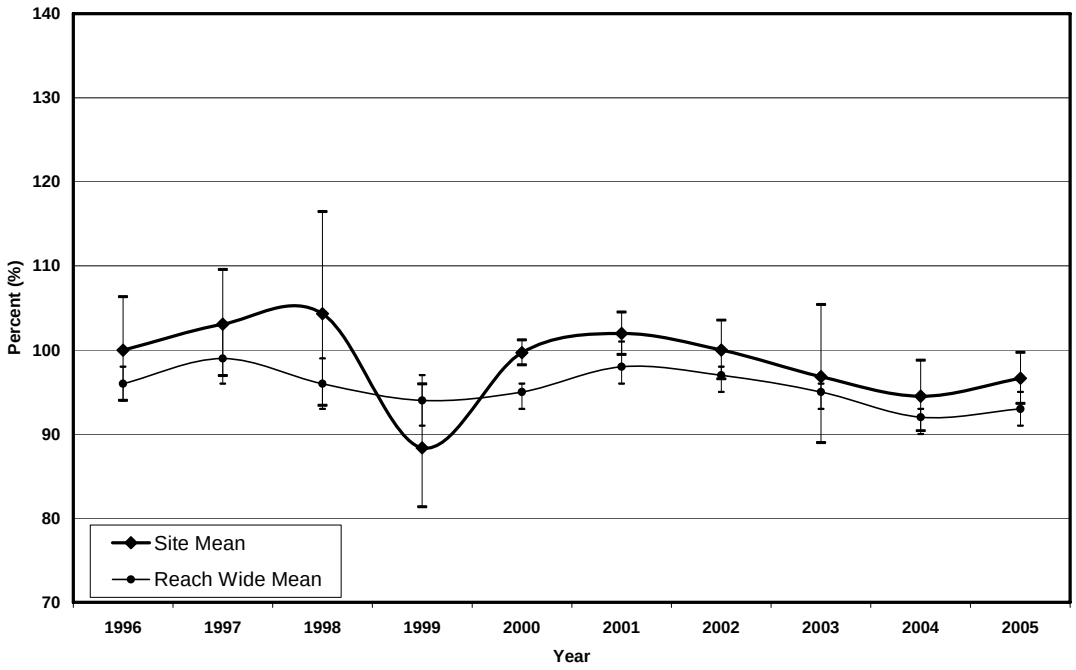
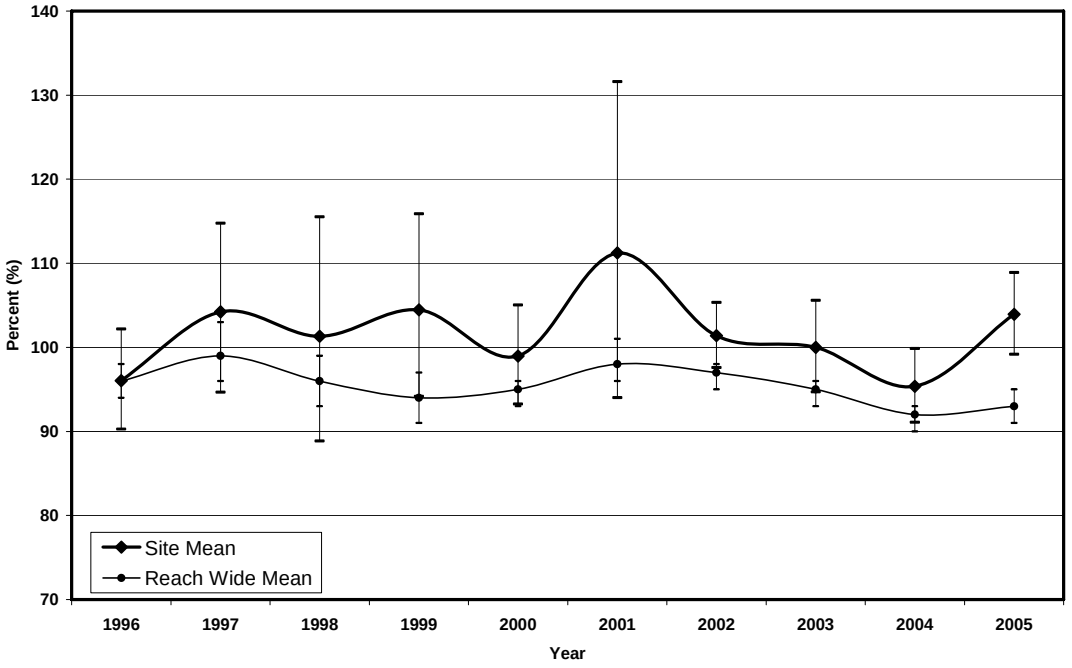


Mean Seasonal Percent Oxygen Saturation for Matamoras-Port Jervis Bridge



Mean Seasonal Percent Oxygen Saturation for Northern DEWA Boundary



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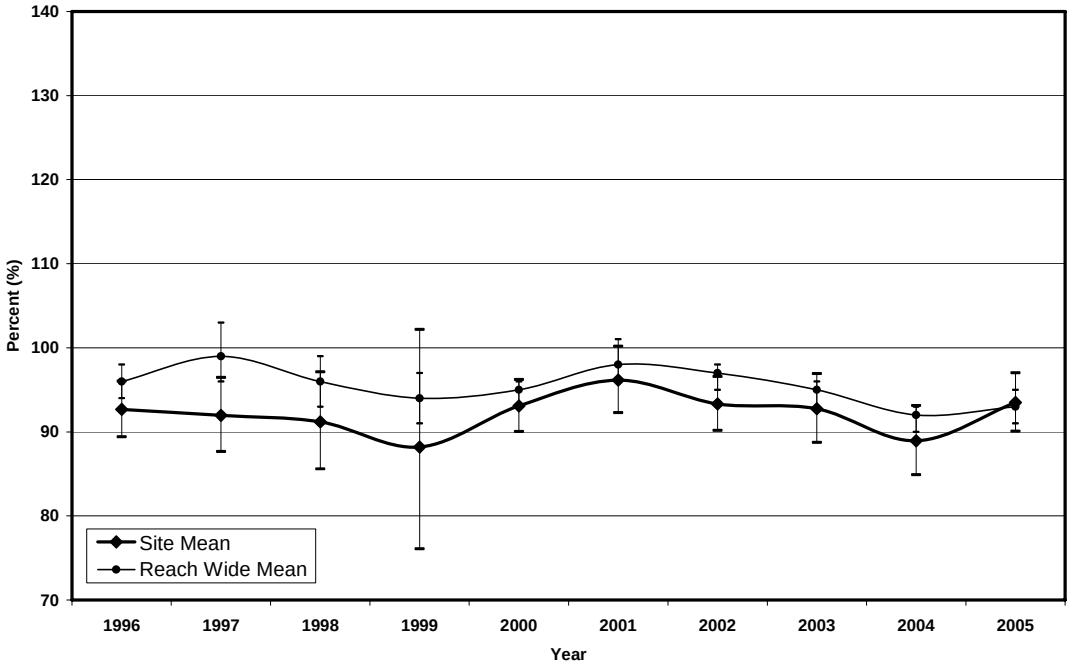

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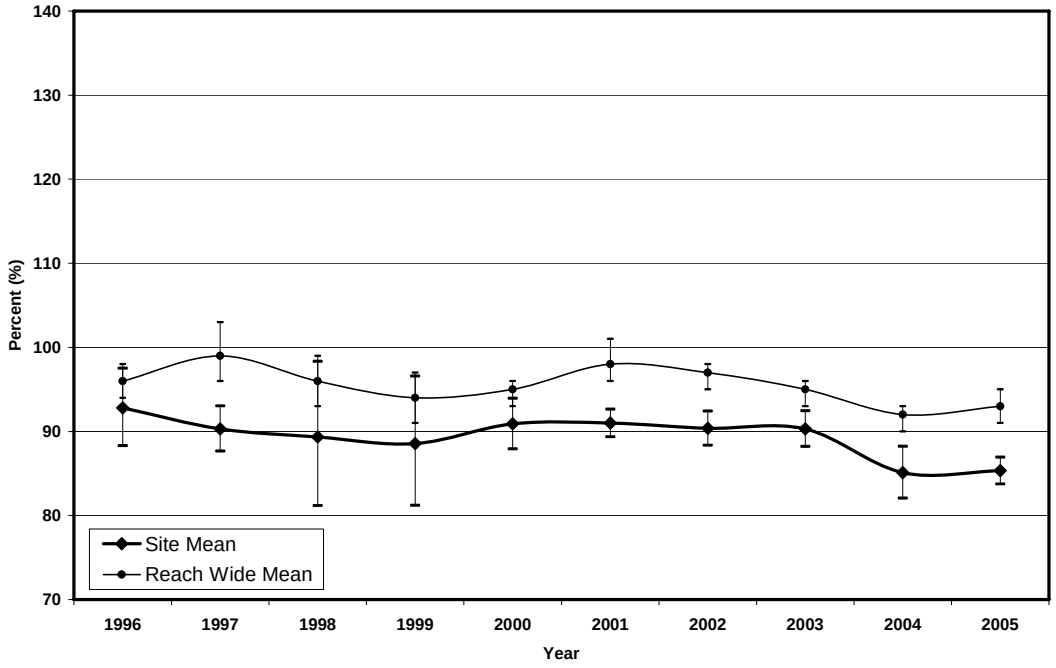

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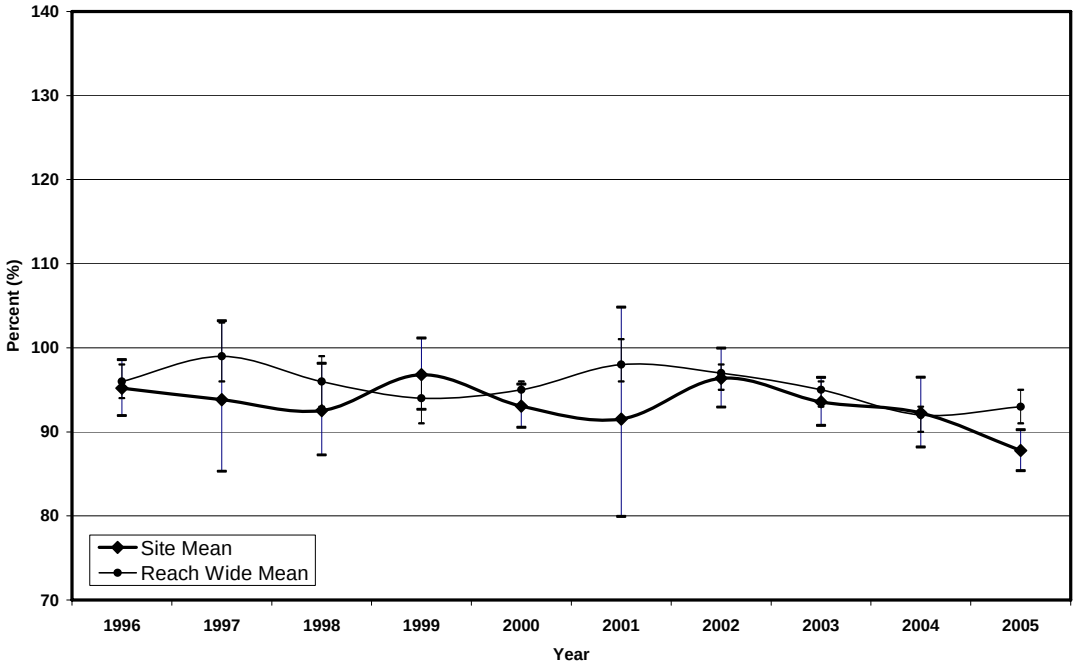

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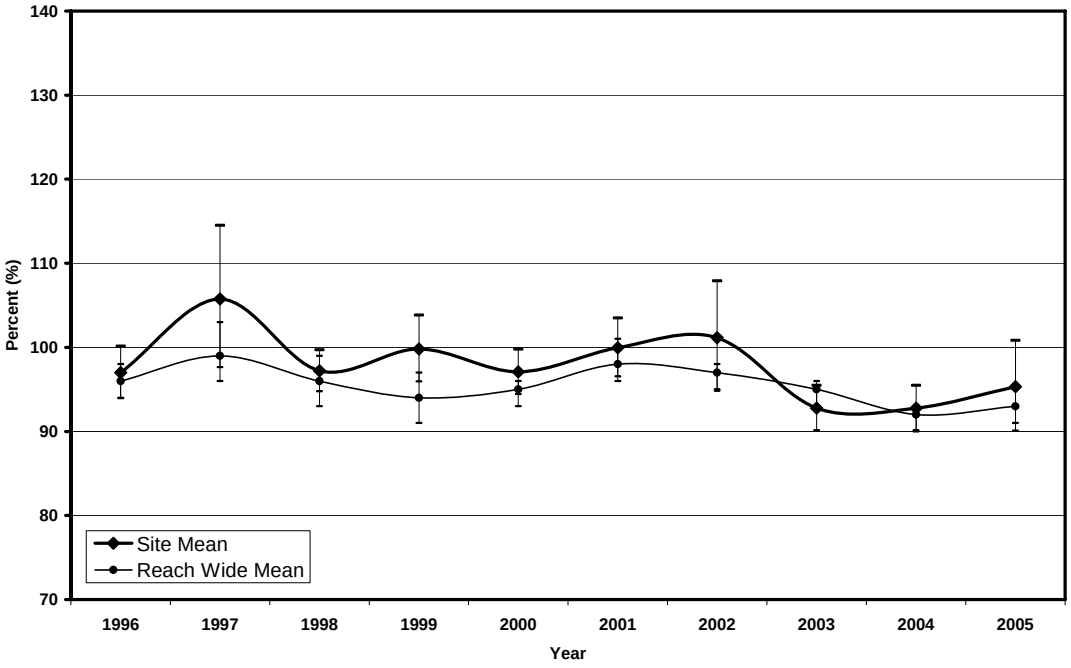

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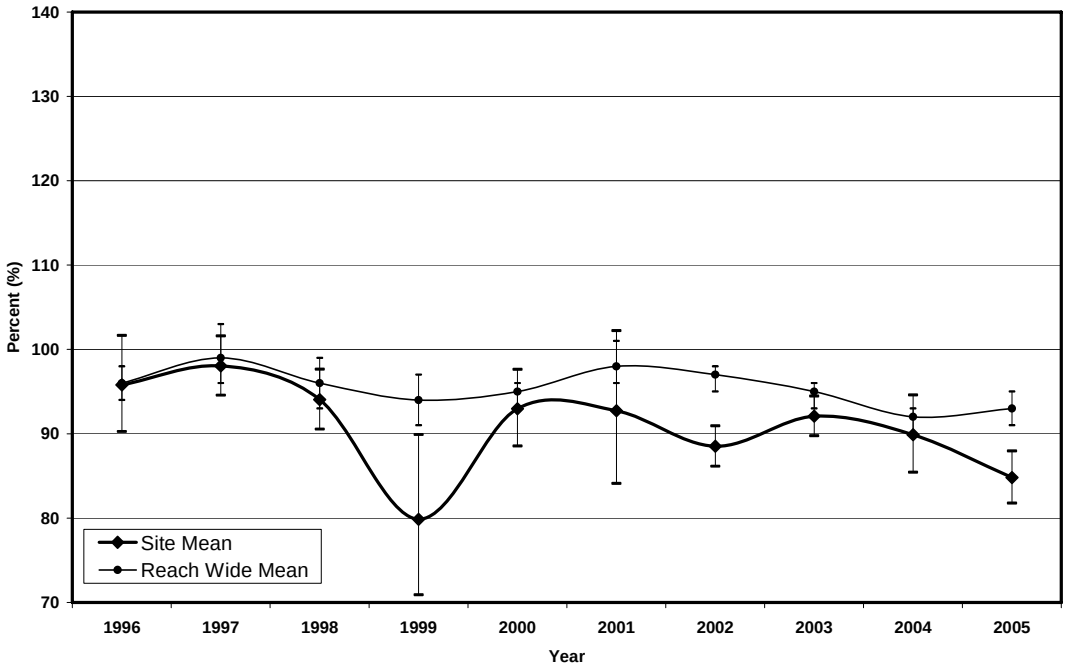
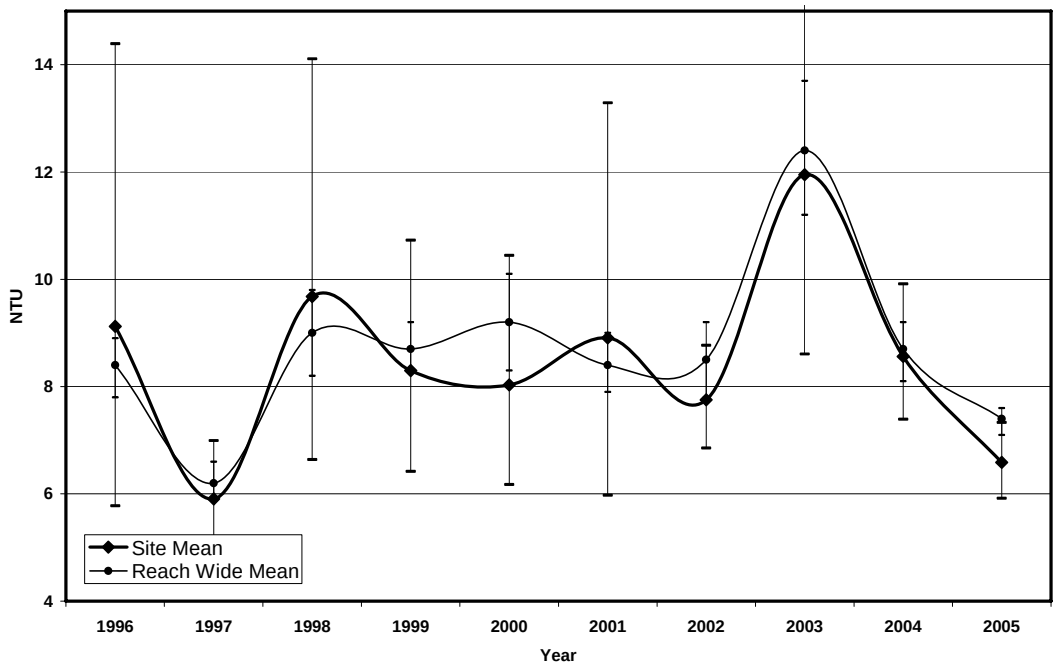
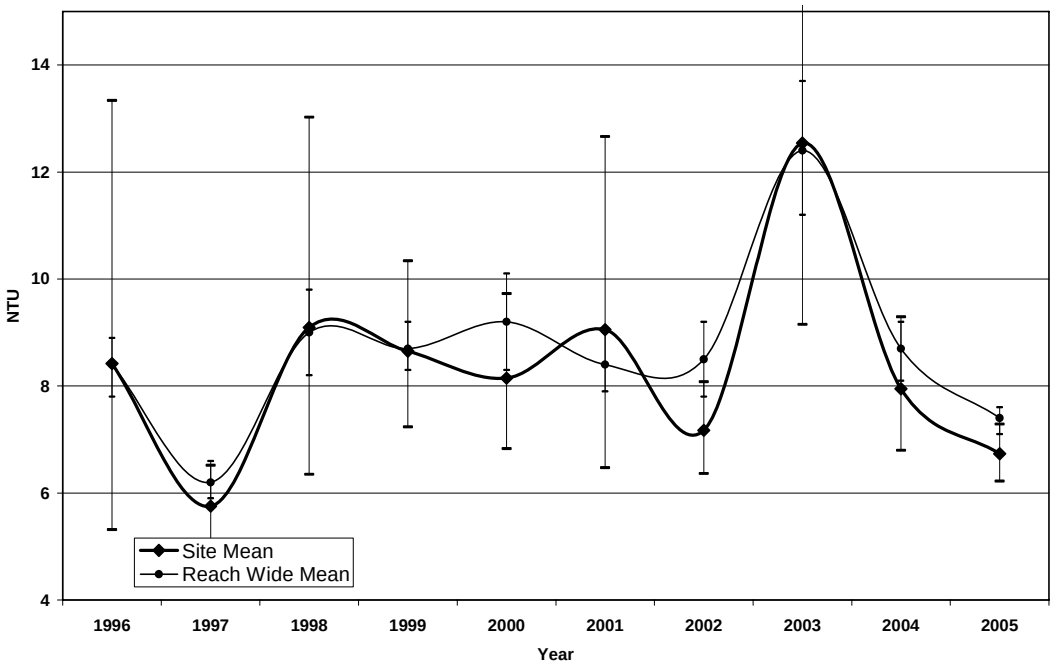


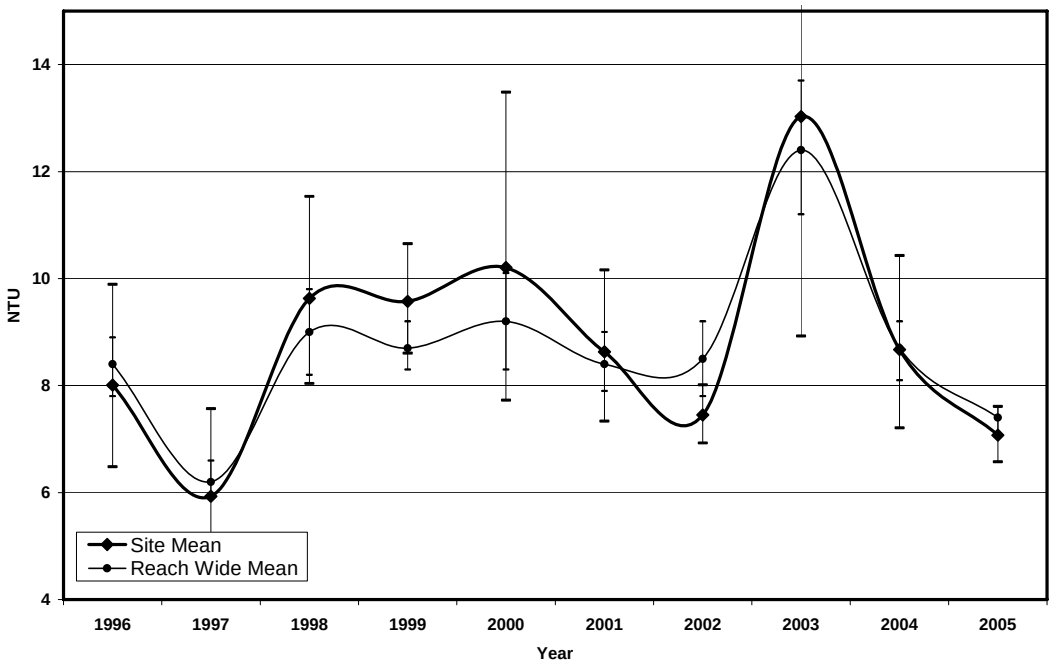
Mean Seasonal Turbidity for Matamoras/Port Jervis Bridge



Mean Seasonal Turbidity for Northern DEWA Boundary



Mean Seasonal Turbidity for Milford Beach



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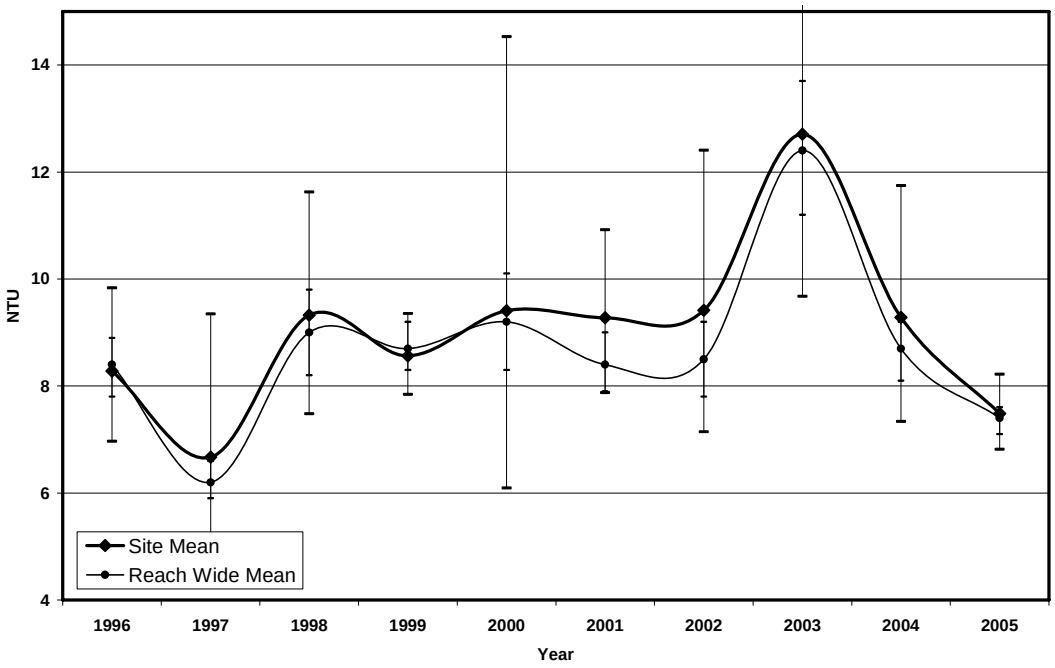
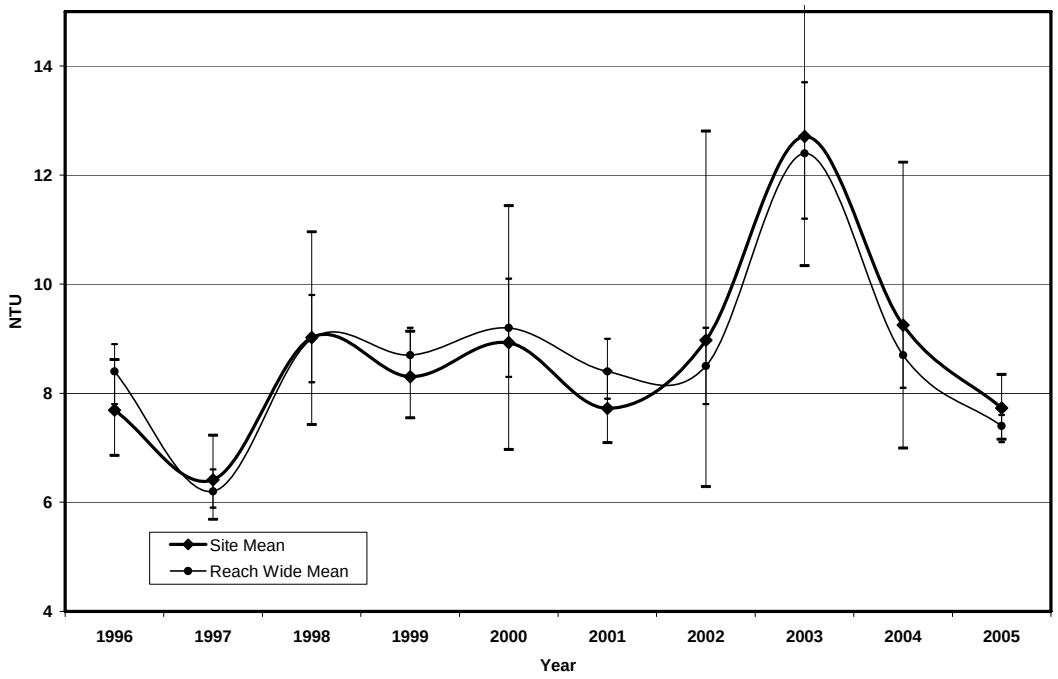
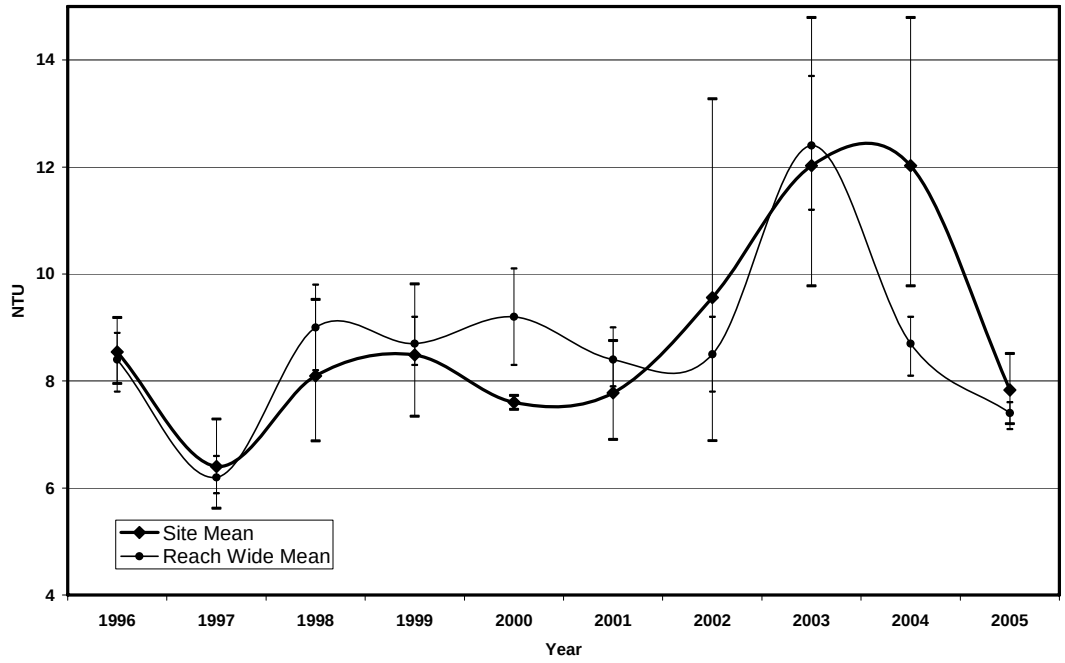


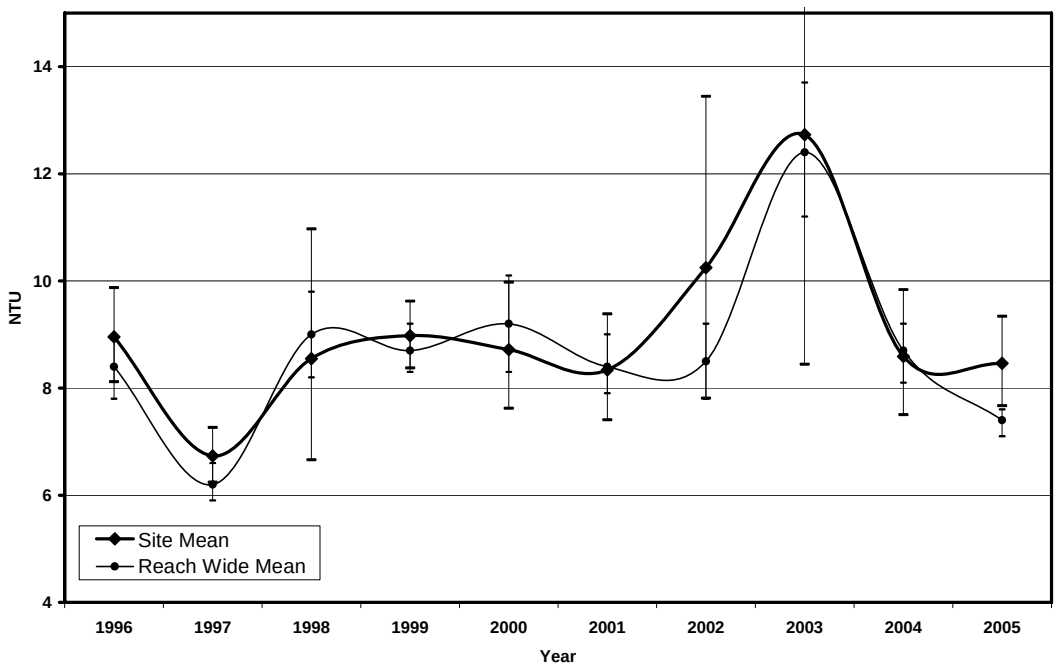
Mean Seasonal Turbidity for Bushkill Access



Mean Seasonal Turbidity for Smithfield Beach



Mean Seasonal Turbidity at Kittatinny Point



COMMUNITY & RESOURCE PLANNING

Prepared by

DeNise Cooke-Bauer
Natural Resource Specialist

ABSTRACT

Community and Resource Planning address the need to review significant actions that could affect people and natural resources within Delaware Water Gap National Recreation Area (DEWA). Proposed plans for development in communities surrounding the park are reviewed, analyzed and reported for potential adverse impacts on park resources. Input is provided to state and local land management plans, water resource plans, and recreation projects both internal and external to park boundaries. Technical guidance is given to park management, staff and external organizations to help protect the park's resources and to ensure the accomplishment of DEWA's mandated mission.

The Resource Planning program deals with in-park projects including building and road construction, maintenance, special use agreements, trails and natural resource management programs. This program usually requires coordination with the Interdisciplinary Team (IDT), the management team and other park committees. The IDT is responsible for implementing the requirements set forth in the National Environmental Policy Act of 1969 (NEPA). One of the most significant changes in implementing NEPA in 2005 is the introduction and implementation of the servicewide, online, interactive tool – the Planning, Environment and Public Comment program (PEPC). PEPC helps the IDT coordinate project review tasks and ensure greater consistency, better communication and project tracking. PEPC also created a unified portal which facilitates consultation and comment from the public and other federal agencies. PEPC was used to collect and analyze public comments from the environmental assessments for the PEEC Cabin Replacement and River Road Rehabilitation. The Resource Planning program manages the PEPC database for DEWA.

Community Planning deals with the sharing of information on activities and projects outside of park boundaries. This program includes participating in developing state and local land/water management plans. Technical information is also provided to the ever-increasing number of citizen-based natural resource organizations. A limited amount of coordination is also done with other federal agencies, such as the Army Corps of Engineers (USACOE), USDA Forest Service (USDA-FS), Geological Survey (USGS), and the Environmental Protection Agency (EPA).

Significant accomplishments of the past year include:

- Ensuring that IDT members completed the Introduction to PEPC training course;
- Managing the PEPC process for River Road Rehabilitation and PEEC Cabin Replacement projects;
- Assisting in preliminary permit application reviews for major construction projects - PA DOT 2001 road rehabilitation and wetland mitigation;
- Serving as the park representative on the Delaware Water Trail steering committee;
- Representing the park on the Pike County Comprehensive Plan;
- Participating in a meeting held by the Pike County Conservation Partnership; and

- Making presentations about management concerns and projects to cooperating organizations and agencies.

Recommendations for program improvement include:

- Continue to expand the use of PEPC among the IDT;
- Improve coordination among park partners;
- Improve communication about park management with environmental (watershed) organizations, adjacent municipalities, and the major tourism organizations;
- Work with other authorities promoting the spirit of regional cooperation for environmental activities among states, counties and municipalities; and
- Research on the effects of deforestation/construction activities on water quality, with emphasis on erosion and resulting sedimentation; study river geomorphology; investigate the use of Civic Engagement principles to develop strategies to improve the park's ability to address external threats to park resources.

INTRODUCTION

Define Community and Resource Planning

The Community and Resource Planning program identifies and reviews significant actions that could affect natural resources, processes and systems within the Delaware Water Gap National Recreation Area (DEWA). Proposed plans for development in communities surrounding the park are reviewed, analyzed and reported for potential adverse impacts on park resources. Input is provided to state and local land management plans, water resource plans, and recreation projects both internal and external to park boundaries. Technical guidance is given to park management, staff and external organizations to help protect the park's natural resources and to ensure the accomplishment of DEWA's mandated mission stated in the enabling legislation.

Community Planning addresses the need to review actions on adjacent lands that may affect park resources (*2001 Management Policies 1.5, 3.4*). At DEWA, this requires coordination with state and local government agencies, citizen-based natural resource groups, and developers.

Resource Planning (*GPRA Goals 1a1A, 1a1B, 1A4*) addresses concerns or identifies problems with in-park projects and activities. Task accomplishment requires coordination with park management, staff, cooperators and partners.

The efforts of the Community and Resource Planning program help ensure that DEWA meets its mandates and mission. The overall goals of the Community and Resource Planning program are to ensure that:

- Federal, state, and local policies or regulations are reviewed to promote the protection of resources.

- Preliminary coordination is conducted with affected communities to identify, anticipate, avoid, and resolve potential conflicts, protect park resources and values and address mutual interests in environmental and resource protection.
- Communication and knowledge about park policies or management of natural resource protection is promoted throughout the surrounding communities.

METHODS

The Community and Resource Planning program focuses on the following tasks in order to accomplish the goals outlined above:

- Identify significant projects and actions in communities around DEWA that potentially have significant impacts on park resources.
- Review, analyze and report on plans dealing with land and natural resource management in communities surrounding the park.
- Represent the park or participate in planning with states, neighboring municipalities, organizations and partners.
- Manage PEPC database and track NEPA process.
- Research policies and regulations of state, federal and local authorities.
- Support external projects that have actions leading to mission accomplishment.

Technical assistance provided by the Community and Resource Planning program includes:

- Coordinate with other federal, state or local agencies or organizations.
- Review project proposals for regulatory requirements.
- Provide guidance on appropriate actions that could be taken to address problems.
- Research policies and regulatory requirements.
- Attend and participate in scoping meetings and site visits.
- Coordinate with other park staff, the regional office and WASO.

Natural resources are typically affected by activities involving soil disturbance, manipulating streams, wetlands, forests and other wildlife habitat features. DEWA encompasses a corridor approximately 40.6 miles long and five miles wide along the Delaware River in Pennsylvania and New Jersey. In 1978 the river reach contained within the recreation area's boundaries was designated the Middle Delaware National Scenic and Recreational River, in recognition of its national significance. The provisions of the Wild and Scenic Rivers Act require that the Middle Delaware "be administered in such a manner as to protect and enhance the values which caused (it) to be included in the system…." The enabling legislation specifically mentions water quality as one of those values. The recreation area's General Management Plan (1987) states that "preventing water quality degradation and retaining existing high quality are of paramount importance…" to protect the values of the park.

The requirements set forth in the Clean Water Act of 1987 and resulting states' legislation *(Clean Streams Law, PA; Water Pollution Control Act, NJ)* provides the base for addressing water resource protection. Additional requirements can be found in Executive Order 11990: "Protection of Wetlands," and Executive Order 11988: "Floodplain Management." Most of the permitting within the park and in the surrounding communities comes under these policies.

Prior to park establishment in 1965, the Delaware River Basin Commission (DRBC) was formed in 1961 to manage water resources in the Delaware River Basin. DRBC and DEWA have worked together to protect the exceptional quality and importance of the watercourses within the park since 1984. The monitoring program that was developed provided the basis for DRBC's Special Protection Waters program, which was adopted for river and tributary water resources in 1992. This program is based on stringent antidegradation requirements and addresses both point and nonpoint source discharges associated with development.

Local agencies are responsible for approving projects needing controls for soil erosion and resulting sedimentation. They are also responsible for enforcing permit requirements at project implementation, including post construction activities. Pennsylvania and New Jersey each have delegation agreements in place that authorize the county conservation districts to administer some state, as well as, local environmental regulatory programs, including regulations that protect the quality of state waters from impacts due to erosion and sedimentation. If the area of disturbance is greater than 5 acres, a permit for the discharge of stormwater from a construction site must be obtained in accordance with the National Pollutant Discharge Elimination System (NPDES), which is a provision of the Clean Water Act, administered by the Environmental Protection Agency (EPA). Although NPDES is a national program, the EPA has delegated authority to issue NPDES permits to the states.

Park projects are presented to the IDT or compliance committee by a project manager for environmental review. Technical specialists analyze or evaluate actions for impacts on both natural and cultural resources. Data gaps are identified, required mitigations are addressed and the appropriate NEPA pathway (EIS, EA, CE) is recommended to the superintendent. PEPC is used for communication between IDT members and facilitates the collection and analysis of comments from the public.

Although Community Planning and Resource Planning are separate management functions, the resources they are addressing are the same, only the audience and policies they follow differ. For instance, when dealing with impacts to wetlands, DEWA complies with Executive Order 11990 (Wetland Protection) and agency policies in addition to the Clean Water Act and appropriate state and local statutes. Areas outside of federal boundaries usually only have to comply with state and local statutes. All park projects and projects receiving federal assistance are required to go through the NEPA process. The Community and Resource Planning program assists with identifying these projects.

RESULTS

Community and Resource Planning activities for 2005 are reported by either Resource Planning (internal) or Community Planning (external).

Resource Planning

Delaware River Water Trail - DEWA participates on the steering committee that is planning and designing the Delaware River Water Trail. The Delaware River Greenway Partnership, Inc. (DRGP), Pennsylvania Fish and Boat Commission (PA F&BC), Delaware River Basin Commission (DRBC), and National Park Service (NPS) are the other major players in this effort. This water trail is intended to enhance the paddling and boating experience and inspire stewardship on 220 miles of the Delaware River from Hancock, NY to Trenton, NJ through a cohesive land and water based trail system. The overall project objectives are to:

- Provide river access sufficient to accommodate different levels of paddlers.
- Provide access information to all trail users.
- Provide resource information to area visitors.
- Promote an ethic of conservation and responsible use.
- Physically connect land-based trails and amenities with the water trail.
- Identify additional or upgraded amenities for appropriate locations.
- Develop stewardship and maintenance strategy for the water trail.

Significant accomplishments in 2005 include:

- Updating the River Recreation Map. This map was originally produced by the DRBC in 1966 and was last updated in 1991. The new draft was twice reviewed by DEWA staff and comments were incorporated. The new map will eventually be available online and possibly for sale through the DRBC and in the park through Eastern National.
- Developing the Draft Water Trail Guide which includes general information on the river's natural and human history, river safety, camping and paddling the river. Input was provided on specific park information, providing graphic images, and making suggestions for the final design.

Planning, Environment and Public Comment (PEPC) - The Resource Planning program provides and coordinates information for in-park projects including building and road construction, maintenance, special use agreements, trails and natural resource management programs. This program usually requires coordination with the IDT, the management team and other park committees. The IDT team is responsible for implementing the requirements set forth in NEPA. One of the most significant changes in implementing NEPA in 2005 is the introduction and implementation of the servicewide, online, interactive tool – PEPC. PEPC helps the IDT coordinate project review tasks and ensure greater consistency, better communication and project tracking. PEPC also created a unified portal which facilitates consultation and comment from the public and other federal agencies. PEPC was used to collect and

analyze public comments from the environmental assessments for the PEEC Cabin Replacement and River Road Rehabilitation. The Resource Planning program manages the PEPC database for DEWA. Seventeen projects were entered into the database in 2005.

Wetland Mitigation by the Pennsylvania Department of Transportation (PADOT) – The rehabilitation of State Route 2001 is requiring the replacement of wetlands that will be adversely affected during the construction phase of the project. The proposed wetland mitigation includes approximately five acres of wetland creation. It will be located on the former Schneider Farm (aka Hornbeck's Agricultural Field) which is currently used to produce agricultural crops. The wetland creation offers the NPS the opportunity to restore the site to a more sustainable wetland wildlife habitat. In 2005, the US Army Corps of Engineers resolved permitting issues and approved the preliminary design.

Climate Friendly Parks – In November 2005, DEWA held a *Climate Friendly Parks* workshop. The workshop was planned collaboratively by the National Park Service-WASO, the U.S. Environmental Protection Agency, and Delaware Water Gap National Recreation Area. This program was created to bring climate change to the fore of sustainability planning in national parks. The three central goals of the program are:

- To inform and educate every park employee about climate change and what role each can take in addressing the problem;
- To identify a strategy for each Climate Friendly Park to reduce their greenhouse gas emissions in order to help mitigate the effects of climate change; and
- To empower every park employee to communicate to the public how climate change is affecting their park's natural resources, how the park is dealing with it, and what a difference each person can make in being stewards of our climate and other natural resources.

Workshop participants proposed four topics where climate change mitigation and air pollution reduction actions could be incorporated and the effects could be realized within a relatively short timeframe. They are: transportation, energy management, waste management, and outreach and education. Action items identified by the participants and the park management team will become part of the *Climate Friendly Parks Action Plan,* which will be finalized in FY 2006.

Environmental Management Plan – Resource Planning participates on the park's Environmental Management Team. This team is responsible for developing and documenting the set of processes and practices that will enable the park to reduce its environmental impacts and increase its operating efficiency. The NPS is required to have an Environmental Management System (EMS) by *Executive Order 13148*, Greening the Government through Leadership in Environmental Management; and *Director's Order 13A* - Environmental Management Systems.

Community Planning

Pike County Comprehensive Plan - Pike County completed its draft Comprehensive Plan. This document will guide the management policies and actions for land use, housing, transportation, economic development, and resource protection for the next ten years. DEWA has approximately 17,589 acres within the county, all located at the bottom of "urbanizing" watersheds. US Census reports that at the time of park establishment in 1965 approximately 10,000 people resided in Pike County; the current population is recorded at approximately 47,000. The projected population estimate for Year 2020 could almost double to 79,000 people. This planning process used a written survey to poll residents on important issues and opportunities for maintaining the quality of life in the county. Preliminary results of the survey show that protecting natural resources ranked high for respondents. Of the natural resources listed, ensuring there was adequate water to maintain the landscape and supply drinking water ranked highest. The Plan is currently being reviewed and it should be finalized by June 2006.

Pike County Conservation Partnership – This is a new effort led by the Pike County Conservation District and focuses on improving the collaboration between local, state and federal agencies. The Conservation District was established in 1956 by the county commissioners primarily to provide for the conservation of soil and water resources and for the control and prevention of soil erosion. It is within their mission to preserve natural resources; assist in the control of floods; prevent impairment of dams and reservoirs; preserve wildlife; preserve the tax base; protect public lands; and protect the health and welfare of the people of Pike County. The Conservation Partnership addresses educational, technical and administrative work done by the Conservation District. In 2005, the group provided input to the commissioners for the successful adoption of the Scenic Rural Character Preservation Bond. The bond will provide funds to allow the county to support innovative municipal planning and permanently protect critical natural resources.

Watershed Organization - Many of the established watershed organizations within DEWA's watershed were working on grants or projects previously supported by the park, so little information was shared with them during 2005. A new watershed organization was established in Smithfield Township, Monroe County. They are concerned about protecting water quality and geologic resources in privately owned area which lies between the park and the Delaware River. DEWA provided guidance for protection and technical information about the natural resources within their watershed.

Development Projects – Community Planning tracked the status of nine proposed development projects. The projects comprise several hundred acres close to the park boundary in both New Jersey and Pennsylvania. They involve commercial, residential, and transportation construction. None of the projects reached the state permitting level in 2005, which is usually where the park provides formal comments.

Water Quality Protection – One of the most significant actions to protect water quality in the Delaware River was the addition Port Jervis Municipal Wastewater Treatment Plant to the DRBC Comprehensive Plan in 2005. The park provided information to the permit

review process and was highly supportive of the Commission's actions. The plant's outfall is located in NY approximately four miles upstream, from the park boundary. It is the largest discharger north of the park boundary.

Activities were also reviewed for withdrawals and sewage facilities in Lehman Township, Pike County, PA and at two facilities in Monroe County.

Other Outreach and Education – Educational presentations on water quality, groundwater or geology were made at East Stroudsburg High School, Halstead Middle School, and at the park's 40th Anniversary Open House.

Community and Resource Planning staff were also involved with the park's Safety Committee and Workforce Diversity Committee. Assistance was also given in the bathymetry study related to developing the Tri-State Bend Water Management Plan.

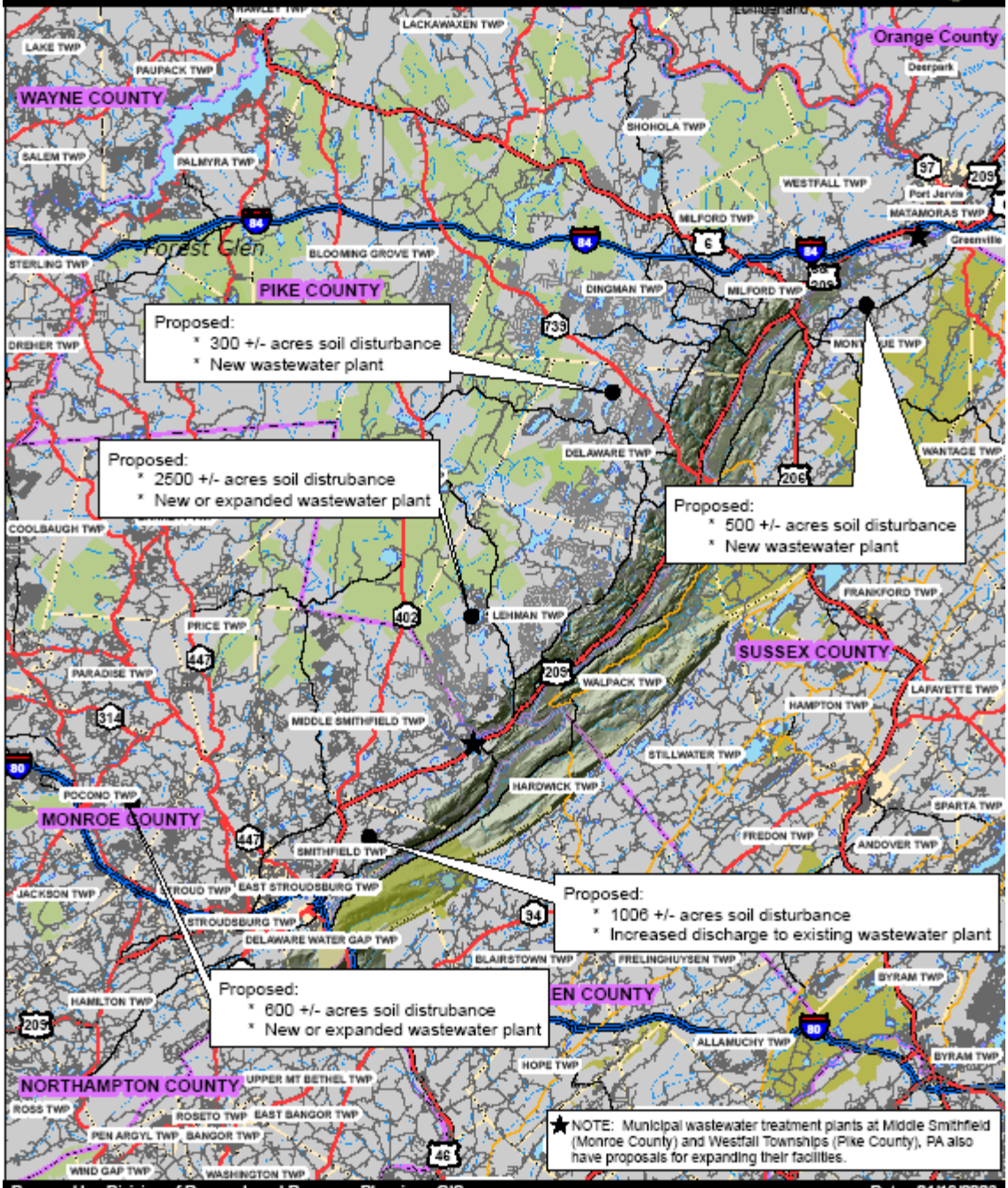
RECOMMENDATIONS

Recommendations for furthering the goals of the Community and Resource Planning program include:

- Continue to expand the use of PEPC among the IDT.
- Improve coordination among park partners.
- Improve communication about park management with environmental (watershed) organizations, adjacent municipalities, and the major tourism organizations.
- Work with other authorities promoting the spirit of regional cooperation for environmental activities among states, counties and municipalities.
- Research the effects of deforestation/construction activities on water quality, with emphasis on erosion and resulting sedimentation; study river geomorphology; investigate the use of Civic Engagement principles to develop strategies to improve the park's ability to address external threats to park resources.

Proposed Development

Delaware Water Gap
National Recreation Area



Prepared by: Division of Research and Resource Planning - GIS
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Date: 01/19/2006
Graphic file: ..\ProposedDev\export\PropDev05.pdf

GEOGRAPHIC INFORMATION SYSTEMS (GIS)

Prepared by

Leslie Morlock
GIS Specialist

and

Kathy Commisso
Cartographic Technician

ABSTRACT

The Geographic Information Systems (GIS) Section of the Research and Resource Planning (R&RP) Division coordinates the GIS programs at the Delaware Water Gap National Recreation Area (DEWA) and the Upper Delaware Scenic and Recreation River (UPDE) park units. The GIS Section is responsible for supporting and enhancing natural and cultural resource research and management, providing support to all divisions within the park units, coordinating with regional GIS programs and technical support units, creating and maintaining spatial datasets, as well as, purchasing and maintaining GIS related software.

INTRODUCTION

The goals of the GIS Section are to provide a comprehensive spatial (geographical) information system that will enable the display, analysis, and modeling of real and theoretical situations for the management needs of all park assets. The section's staff remains at one permanent full-time and one permanent part-time.

GIS products are a standard component for research, analysis, maintenance, and interpretation projects that are central to the park's operation. With the increasing demand for spatial data required to support these projects, the GIS Section's obligation has increased to supply assistance to all of these efforts. Our commitment to supply accurate and current data to our customers, both internal and external, has become a standard that we strive to meet. With our appointed mandate, we endeavor to meet the desire for precise GIS technical assistance and venture to investigate new ways to apply the technology.

METHODS

The GIS Section has several hardware and software resources that allow us to meet and exceed the goals that are set before us. These range from networked computer systems, remote and mobile processors, dedicated GIS software, graphical analysis programs, landscape visualization packages, and data gathering devices. With this assortment of hardware, we can perform the necessary tasks of managing our computer systems, GIS graphic and tabular data analysis software, and data collection responsibilities.

Several computer workstations were replaced with region and division funds to continue to upgrade the R&RP staff to GIS capable machines. A GIS Modeling workstation was also purchased through project funding to assist in computer resource intensive operations.

The server Excalibur continues to support the park Internet Mapping System (IMS). This allows anyone (internal to DOI) with access to the world-wide-web to perform GIS analysis operations and map creation capabilities with the park's geographical data layers, their own local data, or any GIS data available on the Internet. Upgrades for the

IMS software have been acquired and work begins to upgrade the mapping tools and create new programs for the park's use.

The GIS software inventory and distribution continues to increase due to the Enterprise License Agreement (ELA) with ESRI, Inc implemented servicewide in 2004. The list of software merchandise includes ArcInfo Workstation, ArcView, ArcGIS Suite (ArcMap, ArcToolbox, ArcCatalog), ArcPad, and ArcIMS. These programs will augment the other GIS specific software in the inventory which includes ERDAS' Imagine, Blue Marble's Geographic Calculator, and 3-D Nature's World Construction Set. Other software such as Microsoft's Access, Excel, and Word, plus a host of other graphic and data utilities, have enhanced the operation of the major GIS titles listed above. To assist in graphic and report production Adobe Professional and the Adobe Creative Suite were acquired for the R&RP staff. The GIS Section continues to work towards translation of all GIS projects from ArcView 3.x to ArcMap 8.x /9.x format. GIS users throughout the park with the newer Basic GIS computer workstations are being upgraded to the new ArcGIS 9.1 software suite. To assist in this transition, the GIS Section continues holding monthly user group meetings which include training modules, "ArcGIS for Land Management Agencies," developed by North Carolina State University (NCSU) for the National Park Service (NPS).

The GIS Section also upgraded several of the aging GPS receivers and differential backpack units. The park now has 2 Garmin GPSMap 60CS units, 2 Garmin V units, 2 Backpack differential GPS units with Garmin III+ receivers, and 2 Trimble GeoExplorers. A GPS capable Ricoh Caplio Pro G3 digital camera was also acquired to support the Columbia Gas Pipeline monitoring program.

The GIS Section also serves as the regional equipment repository for the Inventorying & Monitoring program. Currently in the inventory are 4 Backpack differential GPS units with Garmin III+ receivers, 1 Backpack differential GPS unit with Garmin GPSMap 60CS receiver, and 3 digital cameras. With these components, DEWA and UPDE staff can accurately obtain spatial location coordinates coupled with any physical feature in the field.

PROGRAM SUPPORT

Upper Delaware Scenic & Recreational River GIS Program Support
Provided GIS technical and product direction for various projects requiring spatially displayed data. This included training for the operation of GIS software, the creation of map products, and the accumulation of data layers for the park unit. The GIS Section also acts as a data repository for UPDE and assists with spatial data requests from other NPS and outside organizations.

Inventory and Monitoring Program at DEWA
Herpetological Surveys - Work continues to support the Wildlife Conservation Society (WCS) to complete the maps, metadata, reports and other deliverables from the surveys conducted. To date, metadata has been completed and the maps produced include:

- Timber Rattlesnake Denning, Basking and Birthing Areas (3 map series).
- A Comparison of Salamander Community Structure in Paired Hemlock-Hardwood Streams.
- An analysis of species distribution and relative abundance in different stream types (3 map series).
- Bog Turtle Presence/Absence Surveys (24 site maps).
- Lizard Inventory: Eastern Fence Lizard and Five-Lined Skink Observations & Surveys (6 map series).
- Temporary Pond Inventory: Wetlands identified in DEWA, and the amphibian and reptile species found at each during inventory surveys in Y2000 (4 map series).

Work is continuing on turtles of concern, Coppermine-Depew swim beach issue, wood turtle management, and bog turtle research.

Water Quality and Watershed Modeling Program
Continued with the inventory and data gathering phase of the park's watershed modeling effort. This included working in conjunction with the Delaware River Basin Commission (DRBC) and the Pennsylvania Department of Conservation and Natural Resources (DCNR) to collect bathymetry, underwater elevation, and data downstream of the 1-84 Bridge to the DEWA boundary. Following this data collection efforts the GIS Section and the DRBC worked together to evaluate all of the river inundation data collected from various sources and combined the data into one master bathymetry dataset that was delivered to the contractor to develop the river channel model. DHI Environmental Service, Inc. is the contractor to develop a water quality model to be used in the Tri-State Significant Watershed Project.

Photorealistic Rendering and Visualization Scenes
Efforts began in 2005 to upgrade the software from 3D Nature's World Constructor Set to Visual Nature Studio as well as increase the number of licenses for the software and obtain a maintenance and support agreement. This upgrade will help streamline the process of using GIS data to display landscapes and the effects that natural resource management decisions could have on those landscapes. This process creates three-dimensional views to accurately visualize geographic features spatially with real-world coordinate-projection values. This provides for the creating of photorealistic images and animations of terrain, forests, deserts, grasslands, clouds, water, and more. With this process, we can now design compelling landscape images that portray proposed management decisions that have a spatial effect before they are implemented. These landscape visualization scenes are invaluable in assisting with the planning process. They are now used for both internal decision-making meetings and within external informational efforts during the policy notification process.

DEWA GIS Internet Mapping Server Program
Maintained current Internet Mapping applications to meet various divisions' needs. These allow GIS capabilities to be distributed throughout the park via Internet access. Users can now perform basic GIS processes and create map products with a minimal amount of expertise, without the need for sophisticated software or equipment, with the assurance of using the most current GIS data. Upgraded software was acquired from region through the Enterprise License Agreement with ESRI, Inc which was implemented servicewide in 2004. Plans for upgrading the mapping applications have begun and will be carried out in 2006.

Some of the applications currently available are:

- DEWA Base Map Application (Provided base map for an overview of the park).
- River Road Map (Included 1939 aerial photography and archival 1874 rectified survey maps of the River Road area. Used for archeological and historical building sites inventories).
- DEWA Location Map (Presented roads & trails, rivers & lakes, streams & creeks, administrative boundary, and property tracts overlaid on top of an aerial photo).
- 1-to-400 Topographic Map (Displayed 1965 topographic maps of the park).
- Previous locations of cultural structures along River Road are displayed through internet mapping.

DEWA Hardware and Software Support
Continued to work with the DEWA information technology staff to provide hardware and software support for the R&RP office and GIS users throughout the park units. This support includes but is not limited to; technical support, hardware and software upgrades, software installation, hardware and software purchases, and hardware set up. Through region, division, and project funds several workstations were acquired and installed. Preparations were made for the migration to Department of Interior network active directory migration carried out in December 2005. GIS users were upgraded to ArcGIS 9.1 and added to the new NPS servicewide network server licensing program for ESRI's ArcGIS software. Work was also started to reorganize and archive GIS data and projects on the Arisbe and Sheridan servers housed at R&RP offices. Work will continue on the reorganization project into 2006 to create a comprehensive data dictionary of all archived data and projects.

DEWA-UPDE GIS Users Group
Monthly meetings were reconvened for the DEWA-UPDE Users Group starting in May 2005 to introduce the new GIS Specialist. These monthly meetings are an avenue for users from all divisions within the two park units to get together and discuss GIS related issues and questions. Part of each meeting is used to highlight particular projects that the GIS Section or other users are conducting within the parks. Many of the users are still transitioning between the older ArcView programs to the newer ArcGIS format. To continue assisting with this transition the second half of the Users Group meetings focus on "ArcGIS for Land Management Agencies" training modules developed by North Carolina State University for the National Park Service.

GIS Web Site

The current GIS webpage was updated with new map products produced by the GIS Section throughout the year. The "Data & Information" section has become a way to share data and information with all of the park's GIS users. Also, the FTP (File Transfer Protocol) site has been a great tool to quickly transfer data between park employees and with other parks.

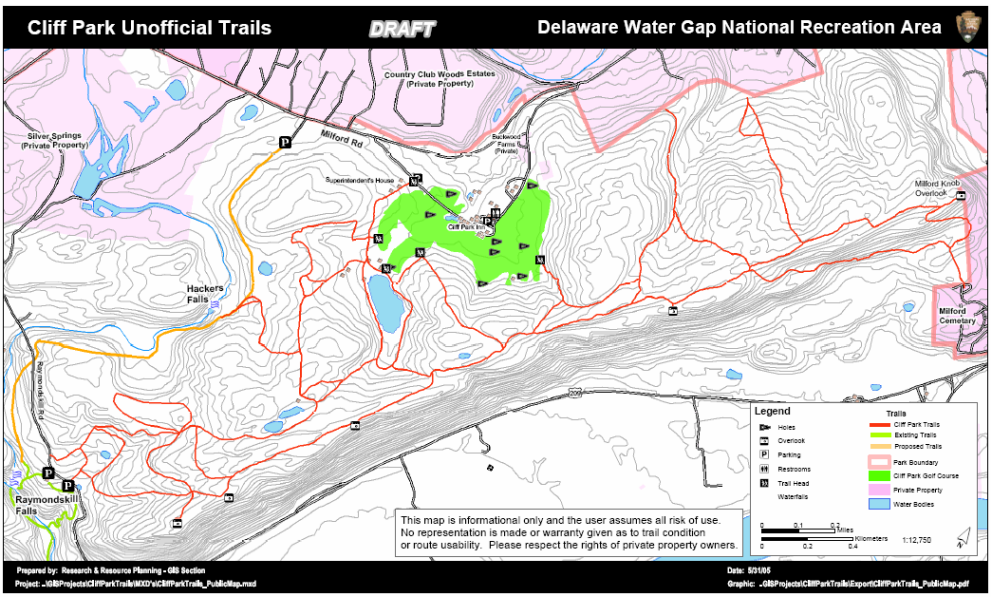
River Valley GIS

The River Valley GIS group was formed as a collaborative effort between the NPS, counties, and other groups surrounding the Upper Delaware River Basin. Participants in this group include representatives from the NPS, Upper Delaware Council (UDC), NASA and affiliates, Shippensburg University, Woods Hole Institute, and Pike County Conservation Association and Pike, Sullivan, and Delaware Counties Planning and GIS staff members. The group holds quarterly meetings and is the steering committee for the Urban Growth Development Model project. The GIS Section plays a key role at these meetings often leading or speaking at the meetings. The GIS Section is functioning as the data repository for all data gathered from the local counties within the Upper Delaware River Basin.

PROJECT SUPPORT

Cliff Park Trails Map Project

At the request of the superintendent and the concessionaires at the Cliff Park Inn, work was conducted by the GIS Section with the assistance of Resource Protection and Visitor Management (RP&VM) to map all of the trails within the Cliff Park property and their connection to existing DEWA trails. In addition all of the golf course feature locations were also collected with the GPS units to produce an accurate map of the property and its trail system to assist Cliff Park Inn visitors, park visitors, and the park management team.



Map of the Cliff Park Trail System.

UPDE River Corridor Protected Lands
The NPS is working with the Upper Delaware Council and the Delaware Highlands Conservancy to identify sections of the river corridor that best illustrate the scenic values and rural character of the region as well as looking at a base for examining future land use changes. Support was provided for this project in the form of gathering tax parcel information and map production highlighting the parcels of land within the river corridor that were greater than 50 acres in size. Another set of maps was created highlighting all of the hunting camps along the corridor. The area of concern followed the UPDE administrative boundaries in both Pennsylvania and New York including the townships/towns bordering the river in Pike, Wayne, Delaware, Sullivan, and Orange counties.

Shawnee Valley Planned Residential Development and Viewshed Analysis
Data collection and viewshed analysis was conducted in the area around the 1006 acre proposed 1601 dwelling unit development in Smithfield Township, Monroe County, PA. AutoCAD data was acquired from the Urban Research and Development Corporation (URDC) illustrating the extent and parcel delineation of the proposed development. A viewshed analysis of the surrounding area was conducted to determine the impact the development would have on the scenic resources of the park. The main area of concern was the ridge opposite the development in New Jersey where the Appalachian Trail (AT) crosses through the park and Worthington State Forest. Photographs and GPS locations were taken at various locations along the AT to illustrate the existing conditions of the viewshed. Using Spatial Analyst in ArcMap, a viewshed analysis was conducted to determine the extent of the development that would be visible from the GPS locations along the AT. This information will be used by the compliance and management teams to assess the impact on the park's resources.

GIS staff member, Kathy Commisso, (above) collecting GPS information along the AT, on the Kittatinny Ridge, NJ overlooking river valley towards the proposed ridge top development in Monroe County, PA.

Grey Towers Laurel Cemetery
Assistance was requested by US Forest Service, Grey Towers National Historic Site, to document gravesite and family plot locations of the 1821 Laurel Hill Cemetery. Global Positioning System (GPS) units were used to locate the features and a map was created which will be distributed to visitors. Training of Grey Towers' staff in GPS theory and data collection strategies was also conducted.

Childs Park Cultural Landscape Study and Planning Efforts
In support of the Childs Park Cultural Landscape study and land use planning efforts, AutoCAD data was collected by Civil Engineering from the contractor and converted into GIS layers by GIS staff to overlay the park's Atlas and General Management Plan maps. This work was done in preparation of larger planning sessions by the management team to be held in 2006.

Hazardous Structures Removal
Work continued on the hazardous structures removal efforts by spatially correcting the FMSS structure locations and updating the demolished structures data layer to reflect addition and deletion changes made to the master list. Buffers around the structures to be removed were also created and distributed to PA and NJ state offices for threatened and endangered species searches surrounding the structures.

Vegetation and Fuels Inventory Map Project
Continued to provide support for the effort to develop a digital vegetation and fire fuels GIS data layer of the park and its environs. The support from the GIS Section has included providing park terrain elevation data, proposed aerial photo coverage extent, and desired digital data parameters. This large project's final digital products are scheduled for completion in 2006.

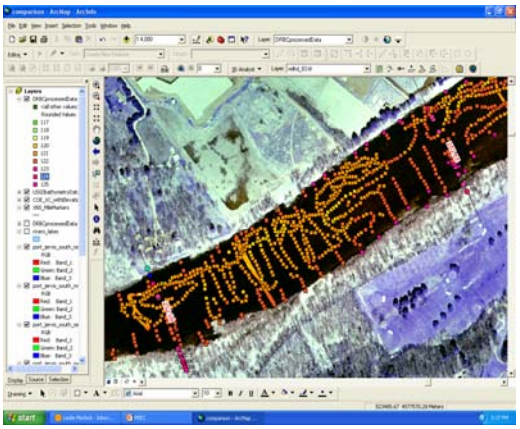
The GIS Section also assisted the UPDE vegetation map process by collecting tax parcel information and providing land owner data on large tracts of land along the corridor to assist the park in finding suitable sites to get land owner permission for accuracy assessment purposes. The UPDE final digital products are schedule for completion in 2007.

Wildland Hazard Assessment (WHAM)
The Fire Management Office at DEWA hired two cartographic technicians for the field season to collect GPS locations and assess the wild fire hazards for those structures throughout the Northeast Region. The GIS Section provided hardware, software, and technical support to the fire and cartographic technicians to assist their data collection efforts in DEWA and UPDE. The data collected from this project will be used to correct and augment the existing structure data for the park units.

Tri-States Watershed Management Project/DHI Model
The Tri-States Watershed Modeling project continued to move forward towards the goal of a completed hydrodynamic model. To correct gaps and potential errors in the bathymetry data collected by the USGS in the fall of 2004, a collaborative data collection effort was carried out by GIS/R&RP staff, DRBC, and the PA DCNR. The GIS Section collected all of the data from the various sources and delivered it to the DRBC for elevation corrections. The final dataset was given back to the GIS Section for analysis and distribution to DHI. DHI is currently building the hydrodynamic model and the GIS

Section and the water quality intern are assisting by reviewing aerial photography and other sources to help determine sections of the river where the roughness value changes to help fine tune the calibrations of the model. Once the model is completed it will be handed over to another DHI representative to develop the water quality portion of the project.

R&RP staff Melissa Stepek & Patty Tipson collecting manual bathymetry data.



Bathymetry Elevation Data shown in ArcMap

Urban Growth Model Project – River Valley GIS "Data Library"

Work continued on the Urban Growth Model Project including assisting with quarterly meetings with the River Valley GIS steering committee. Extensive work was carried out on collaborating with the county governments within the Upper Delaware River Basin to gather the necessary GIS data layers. After receiving the data from the various sources all of the data was sorted, organized, and reprojected to match the NPS and project preferred projections. New datasets were created and customized to work within the project parameters. Collecting and working with the county datasets continues. Delivery of the existing data for the Pennsylvania side of the project to Shippensburg University will by completed before the new year so that model work can begin in 2006. The GIS Section staff members are keeping track of their hours associated with this project as a part of the in-kind service for the Growing Greener Grant procured by Pike County to fund the model project.

Consequences of Land Cover/Land Use Changes on National Parks

In conjunction with the Growth Model Project, NASA's New Investigator Program has been developing a historical land cover/land use change from Landsat 7 satellite images of the Upper Delaware River Basin to train the SLEUTH Model used to project urban growth. "SLEUTH" is an acronym for the data inputs required for the model: *S*lope, *L*and cover, *E*xclusion, *U*rbanization, *T*ransportation and *H*illshade (or background image). This data is also being used by NASA to develop a model to show the consequences of changes on water/energy cycles using the GAPS Model. An educational component is a major part of this project working with the NPS, NASA, area schools and the GLOBE (Global Learning and Observations to Benefit the Environment) program to develop a pilot curriculum on land cover changes. The GIS Section has been involved in supporting NASA through acquiring and supplying aerial and satellite images of the

region. We have also been active in the educational workshops held at the Pocono Environmental Education Center (PEEC) in October and working with area schools to conduct ground truthing exercises following the GLOBE protocols to assist and correct the land cover/land use data gathering.

Students from Delaware Valley High School Fall Geography Class (11/6/2005) measure tree height with homemade simplified Clinometer from the GLOBE Program for the LandCover/LandUse Study. (Right - in woods behind Dingmans Ranger Station.)

NJ Swim Beach
Maps and survey locations were provided to management regarding turtles of concern at the Depew Recreation Area and the proposed swim beach site at Coppermine. Comfort stations at Worthington State Forest were GPS'd in order to compare feature elevations with the proposed comfort station at the Coppermine site.

DATA LAYER ACQUISITION, DEVELOPMENT AND DISTRIBUTION

Sustainable Comfort Stations (Civil Engineering) - Locations of 22 comfort stations were identified on 1:24000 USGS quarter quadrangle paper maps and then digitized into a GIS layer. This information was used to determine if the locations were within the 100 year floodplain. Since this information is now in digital format, further mapping and analysis can be conducted if necessary.
Updated Hydrography – Using the 2002 aerial images obtained for the vegetation mapping project, the lakes and river layer and the streams layer were updated to reflect current conditions. Accuracy assessment still needs to be conducted.
Updated Roads and Trails – Accuracy assessment and quality controls have been completed and the new roads GIS layer has been distributed and is currently in use. Trails have been extracted from the old roads and trails shapefile and data layer development continues.
Structures – Accuracy assessment and quality controls have been applied to the GPS data collected for the Wildland Hazard Assessment. We now have a complete structure layer including names and FMSS numbers.
DEWA Base Cartographic Data CD – Working in conjunction with North Carolina State University (NCSU) a Compact Disk (CD) was created containing all of the base GIS data with metadata. These CDs are designed to be distributed to contractors.
Upper Delaware Basin DEM – Acquired and distributed 10 meter Digital Elevation Model (DEM) quads to NCSU for a seamless merged 10 meter DEM of the entire Upper Delaware River Basin.
ASTER Satellite Image – Following the flood event in April 2005 the Aster Satellite, part of NASA's Earth Observation System (EOS), was tasked to acquire two visible near

infrared (VNIR) scenes to complete a 15 meter resolution image of the entire Upper Delaware River Basin.

Chestnut, Johnny, Kittatinny Ridge and Woods Fires Mapped (Fire Management Office) – GPS data were received from the fire technician and GIS layers were created for each fire.

GIS MAP PRODUCTS (DIVISIONS OR PERSONNEL SUPPORTED)

Large Atlas Maps (Maintenance/Dispatch/Management) - Large scale atlas maps were created to replace the one in the maintenance chief's office and in dispatch. Comments have been received and a final map will be printed and mounted for display.

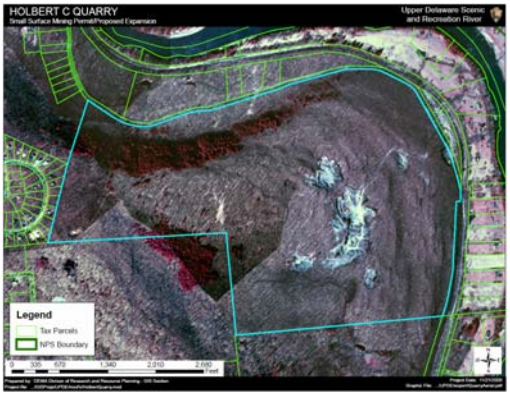
Historic Preservation Display Map (Interpretation - Cultural Resources) - Designed a large map of the entire park highlighting the locations of several historic houses to be displayed along with photographs illustrating the preservation efforts within the park.

Hunting Buffers (VP&RM) – No hunting zones were established with GIS by producing 450' buffers around the Cliff Park and PEEC structures. Waypoints were created from the buffer and uploaded into the GPS units for field marking of no hunting boundaries.

Boundary Disputes (VP&RM) – Assisted law enforcement rangers with data and maps surrounding boundary dispute areas.

Delaware River Flooded Areas (Management) - Created maps displaying the flooded areas from the April 2-3, 2005 flood based on the elevation readings from the Montague and Tocks Island gauge stations.

Holbert Quarry Special Permit (UPDE Management/Upper Delaware Council) - Several maps were produced showing the location of the Holbert Quarry and the quarried area as seen on the aerial image for the special permit review process. Map of the Holbert Quarry that appeared in the Dec. 8 - 14th, 2005 edition of *The River Reporter* along with an article about the Special Permit application (right).



UPDE Mongaup Visitor Center (UPDE Management) - Created maps showing the potential sites for the new visitor center near the Monguap River access.

NJ Bear Hunting Zones (R&RP/Management) - Produced maps based on those provide by the State of NJ showing the bear hunting zones and projected number of permits to be issued.

Metz Ice House & Santos Property (Management) - Produced a large map of Milford Borough area between the Metz Ice House and the Santos Property showing park boundary and tax parcel lines for a charette.

Regional Project Map and Support (Cultural Resources) – Basic regional location map was created to be inserted into other projects as a picture.

Housing Plan Map (Management/Administration) - Created a map of park buildings used for employee housing color-coded according to the management plan. Regional location maps were also created to be included with the report.
River Corridor Hunting Camps (UPDE Management) - Produced maps of townships and towns along the Upper Delaware River corridor highlighting the hunting camps within the corridor.
River Corridor Large Tax Parcels (UPDE Management) - Produced a series of maps and tables of the Upper Delaware Corridor highlighting the tax parcels and ownership of parcels greater than 50 acres.
PEEC GPS Activity– Support was provided to PEEC staff for a GPS training curriculum including supplying data, and the use of hardware and software to create maps. Technical support was also provided to assist PEEC in setting up their own mapping station.

PARTNERSHIPS AND DATA SHARING

Pike County, PA – Continued data sharing efforts and obtained GIS data for entire county including tax parcels, road centerlines, and zoning files coordinated through River Valley GIS Group.
Monroe County, PA – Continued efforts to form a data sharing agreement and received county GIS data and aerial photography.
Wayne County, PA – Continued GIS data sharing endeavor to obtain tax lot property lines for parcels within and adjacent to the park.

Sussex County, NJ – Coordinated data sharing and obtained some GIS data layers
Warren County, NJ – Established contact and began efforts for data sharing agreements.

Delaware County, NY – Coordinated data sharing through River Valley GIS Group to obtain GIS data.
Sullivan County, NY – Coordinated data sharing through River Valley GIS Group to obtain GIS data for tax parcels, open space, zoning, and road centerlines.
Ulster County, NY – Established cooperative data sharing and received GIS data including tax parcels, road centerlines, and zoning data.
Broome County, NY – Established and signed (UPDE Management) data sharing agreement to obtain GIS data.

OTHER MISCELLANEOUS ACTIVITIES AND TRAINING

GLOBE Workshop – Assisted visitor services staff in recruiting local teachers to attend GLOBE Land Cover/Land Use workshop held October 7th, 2005 at PEEC. A presentation on DEWA, R&RP and GIS was given to the attendees. The GIS staff also participated in the workshop activities.
Land Cover Field Trips – Assisted on two field trip outings with students from Delaware Valley High School to conduct land use/land cover exercises from the GLOBE workshop.

GIS Day – The GIS Section sponsored their first International GIS Day events on November 16th, 2005 for members of the DEWA and UPDE staff. Other attendees included PEEC staff. The event included a presentation by GIS staff about GIS and how it is used within the park units. Posters were also put together and displayed at both headquarters on GIS, GPS, and current GIS related projects. Other GIS users within the parks were encouraged to participate in the poster displays. Posters were submitted by Rich Evans (R&RP) on the Hemlock Woolly Adelgid Project and Lori Rohrer (Cultural Resources) on various archaeology projects. Lori was awarded a GIS Day mouse pad for her participation. Other displays included posters of the Aster satellite image and Landsat 7 image of the region with challenges to find cultural and natural features on the images. A contest of aerial images from both parks was displayed for participants of GIS Day to test their knowledge of various park features from a sky view. Participants were invited to write their answers on a sheet of paper to enter the contest. The winner was Chris Nelson (Administration) who won a GIS Day mouse pad. Those who assisted Chris in her correct identifications of the sites are invited to visit the mouse pad at Chris' desk at headquarters.

UPDE Staff Meeting Presentation – The presentation from GIS Day was also given to the entire UPDE staff during their December staff meeting to introduce the concepts of GIS and how it is used within the parks.

DVHS Geography Class Presentation – A presentation on DEWA and GIS was given to the geography class at Delaware Valley High School on November 16th, 2005 as a part of the GIS Day activities.

ESHS Remote Sensing – A presentation on remote sensing and how it is used by the park, was given by the GIS staff to the East Stroudsburg High School Environmental Club. This presentation was designed to help the students learn more about remote sensing technologies and how to use them to help with their Science Olympiad competition.

GPS Training – Basic GPS training was provided to the DEWA superintendent and to the staff at Grey Towers.

ArcGIS Training – Modules from "ArcGIS for Land Management Agencies" and other "how-to" sessions are conducted monthly at the DEWA-UPDE User Group meetings.

RESULTS

This year the GIS Section worked hard to continue to provide prompt and quality support and map products to DEWA and UPDE through a period of reduced staff and the hiring of a new GIS specialist. The staff strove to improve the accuracy of the GIS data sets and improved distribution of data and software to all GIS users. Work continued with regional GIS staff to implement the changes in upgrading software and licensing strategies. The GIS Section continued to implement strategies set forth in the GIS plan including organizing GIS data and projects on the new server to make the most efficient use of digital storage space. Through the GIS Users Group and other events like GIS

Day, the staff has been actively working to increase the understanding and use of GIS in all divisions throughout the park and continues to train users on the upgraded software programs. With all these efforts and goals, the section this past year has been successful in achieving its mandate to support the GIS activities at DEWA and UPDE and their cooperating partners.

RECOMMENDATIONS

In order to meet the increasing needs for GIS, the GIS Section will continue to increase its outreach, training, and education on the benefits of using GIS as a management tool and making GIS capabilities available to interested employees through software or internet applications. The GIS Section will continue to look at the changing needs of the parks and new technologies to provide the best support available. In order to accomplish these goals, the GIS Section will work to upgrade, design, and promote the use of the Internet Mapping System applications. In addition, the GIS Section will look into the feasibility of creating ArcReader projects to assist the management team's access to the data and applications from their desktops to start familiarizing themselves with the program and its uses.

The GIS Section will continue to organize and archive the GIS data and projects to provide the most up-to-date data easily accessible to the users, including data distribution strategies and updates throughout the two park units. A particular effort for data collection should be applied to the UPDE data sets to allow the creation of a comprehensive atlas map for the park. Due to the work load it would benefit the park and the GIS Section to look at augmenting the GIS Section staff with a VIP, IVIP, or SCA position. Having a temporary employee will assist in the collection, creation, and updating of data to ensure the best possible products.

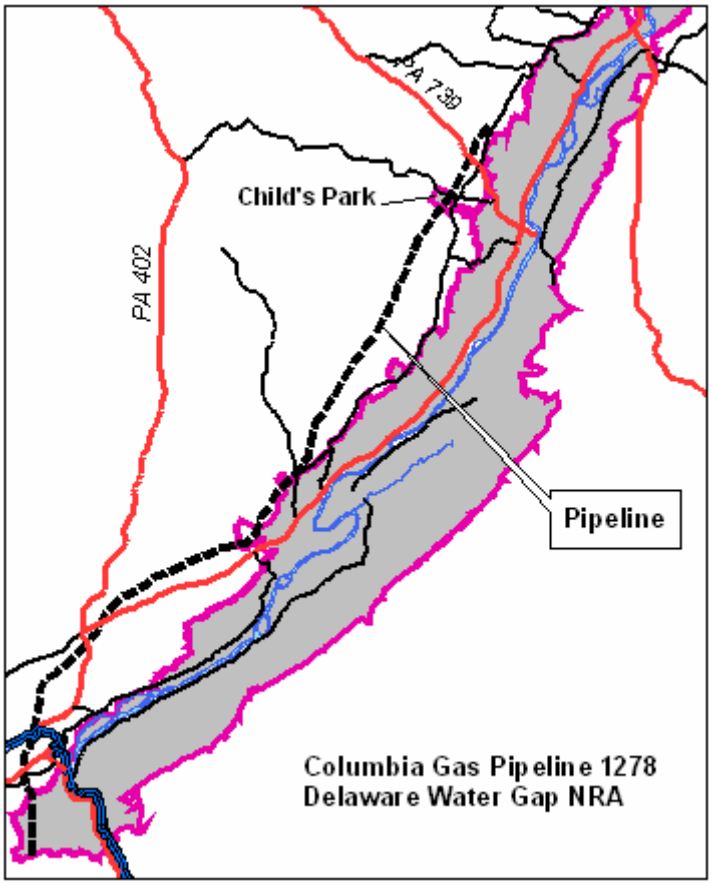
The GIS Section staff should continue personal training to keep up-to-date on the latest and ever changing technologies related to GIS, as well as utilize visualization software to the best extent to display and "bring-to-life" real and simulated scenarios to assist in management decisions for all resources.

The GIS Section will also continue to work with existing and new partners to improve their understanding of the surrounding region and take full advantage of the various resources available through sources outside of the NPS.

COLUMBIA GAS PIPELINE PROJECT

Prepared by

Patty Tipson
Natural Resource Specialist



INTRODUCTION

In August 2005, Columbia Gas began work on a two-year gas pipeline replacement project, as mandated by the United States Department of Transportation. The project involved the removal and replacement of 43.4 miles of pipeline, with 3.5 miles running through Delaware Water Gap National Recreation Area (DEWA). The current pipeline was installed in 1947, and its age and diminishing capacity called for an upgrade as soon as possible. A biological science technician was hired to oversee the site preparation, pipe installation, and restoration of park resources.

A 50-foot permanent right-of-way (ROW) was used, and in some instances, an additional 25-foot temporary ROW was disturbed as well. Extra work spaces, or staging areas, were also cleared and utilized during construction. Following construction and restoration to pre-construction contours, the ROW is seeded and replanted with native species.

Year one included a half mile section within the Childs Park portion of DEWA. Within this half mile were two stream crossings and one wetland crossing. The remaining three miles will be completed in 2006.

Southern Slope of Dingman's Creek

Before **During** **After**

Invasive Species Monitoring & Control

In order to minimize the introduction of invasive species into the work area, Columbia Gas agreed to implement the following measures:

1) herbicide treatment of existing targeted invasive trees and shrubs immediately following cutting;
2) use of weed-free seed, mulch, and gravel; and
3) cleaning of vehicles and equipment before entering the park to remove vegetation and soil.

One targeted undesirable woody species, Multiflora rose, was found in the Childs Park ROW. A licensed herbicide sprayer was brought in by Columbia Gas, and the freshly cut stumps of this species were sprayed with an NPS-approved herbicide.

The ROW will be monitored by Columbia Gas for two years following restoration and spot treated to kill or remove target invasive weeds.

Safety

To keep the work area and our visitors safe, safety fencing was installed around the work area. Trails that crossed the ROW were closed off and "Area Closed" signs were posted.

Area Closed Sign

Safety fence installation

Erosion Controls

The Columbia Gas environmental team used several preventative measures to protect sensitive resource areas such as waterbodies and wetlands. Temporary and permanent erosion controls implemented included: silt fence, sandbags, trench breakers, slope breakers, coir fiber logs, straw bales, sediment control blankets, mulch, and revegetation.

During active construction, daily inspections of the erosion controls were conducted. In areas where there was not active construction, inspections were done on a weekly basis and during rainfall events of 0.5 inches or greater.

Covering Dingman's Creek crossing with filter fabric

Installing silt fence

Installing sediment control blankets

Coir fiber logs

Stream & Wetland Crossings

Seasonal crossing restrictions were in place for Dingman's Creek and a tributary running through Child's Park. In-stream restrictions of March 1- June 15 and October 1 – December 31 were followed, with both crossings completed in the month of September. "Dam and pump" methods were used to cross both waterbodies. "Dry ditch" crossings, such as these, usually result in less turbidity than open cut crossings. Both crossings were successful, with little sediment moving downstream.

During one rain event, a weak spot in the erosion controls occurred after hours and a substantial amount of sediment was sent into Dingman's Creek. Columbia's environmental crews corrected the problem by bolstering the erosion controls in that particular spot. Columbia Gas also cleaned up sediment that was deposited on the rocks below the break. No further events occurred throughout the construction project.

Spill prevention kits were stationed at all waterbodies and wetlands and refueling within 100 feet of waterbodies was prohibited. Equipment bridges were installed across both creeks, and were maintained daily to prevent soil from entering the waterbody.

Dingman's Creek before construction

Dingman's Creek after pipeline replacement

A .14-acre wetland lies within the ROW, just south of Silver Lake Road within Childs Park. Heavy construction equipment must work off of temporary equipment mats at all times (right). During excavation and pipe installation the wetland was temporarily impacted, but was restored to pre-construction contours after construction. An NPS-approved wetland seed mix and native woody species were planted in fall of 2005.

Restoration

Restoration efforts were concentrated on the temporarily impacted wetland and riparian areas. After grading to pre-construction contours was completed, over 1,300 native tree and shrub species were planted within the temporary ROW. The entire ROW was also reseeded with native upland, riparian, and wetland seed mixes and then hand-mulched. Each area that was planted with woody species was also enclosed with an eight-foot deer fence, which will be maintained by Columbia Gas. Numerous visits to the construction area after restoration showed some germination of the annual rye. It is expected that a suitable herbaceous cover will establish itself in the spring of 2006.

Trees planted inside of deer fence

Woody species that were planted outside of the deer fence were treated with two forms of deer repellent: garlic clips and "Tree Guard" deer repellent spray. Upon a visit to the site in early January 2006, trees and shrubs with the garlic clips appeared untouched while those plants where the clips had fallen off showed some signs of deer browsing.

Riparian area restoration

A 70 percent uniform germination over a two-year period is required for the seed mix to be considered permanently stabilized. An 85 percent survival rate after three to five years of onitoring is considered a successful restoration for the woody species. Columbia Gas and DEWA staff will continue to monitor the site.

References

Federal Energy Regulatory Commission. 2005. Line 1278 Replacement Project Environmental Assessment.